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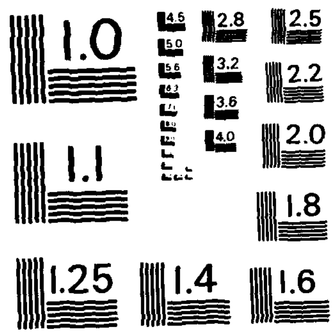

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COST ANALYSIS OF FTS VERSUS COMPARATIVE WATS SERVICE AT SELECTED ARMY CONUS LOCATIONS

Prepared by:

HEADQUARTERS
US ARMY INFORMATION SYSTEMS COMMAND

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US ARMY INFORMATION SYSTEMS COMMAND

FORT HUACHUCA, ARIZONA 85613-5000

COST ANALYSIS OF FTS VERSUS COMPARATIVE WATS SERVICE AT SELECTED ARMY CONUS LOCATIONS

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DISCLAIMER

EXECUTIVE SUMMARY

I. OBJECTIVE. The objective of this study is to compare the economic advantages and disadvantages of the Federal Telecommunications System (FTS) to Wide Area Telephone Service (WATS)

II. BACKGROUND.

A. During a previous Program Evaluation of the Defense Metropolitan Area Telephone Systems (DMATS) at Boston and St. Louis, the DMATS management personnel pointed out that FTS was a more expensive form of long distance telephone service than WATS. This was informally confirmed by the Air Force DMATS staff in Dayton, Ohio.

B. The House Appropriations Committee (HAC) of the US Congress, in 1979 and 1980, directed the Department of Defense to increase participation in the FTS program where operationally and economically feasible. As a result, the US Army Communications Command (USACC) accelerated its emphasis on the FTS program and 7th Signal Command and other subordinate units perceived command policy to be that FTS is the preferred method of providing long distance telephone service.

C. From the time of the congressional mandate to expand the use of FTS in 1979 to the end of 1983, significant changes occurred within the telephone industry. The Telecommunications Package (TELPAK) was eliminated and the telephone industry started through deregulation and divestiture.

D. In response to this changing environment and the possibility that FTS was not the most economical telephone service, the Comptroller US Army Information Systems Command (USAISC) made a decision to do an indepth analysis of FTS and WATS. In addition, the acquisition procedure to obtain an automated model that can analyze telephone traffic data for any location and determine the most cost effective mix of all telephone services was initiated.

III. CONSTRAINTS. This study is limited to an evaluation of FTS and WATS. An evaluation of other telephone services will be done at a later date.

IV. METHODOLOGY. The procedure used to compare FTS costs to WATS costs was to cost FTS traffic using WATS tariffs. A sample of FTS traffic was obtained from the General Services Administration (GSA) for Army activities. Ten CONUS sites were selected for evaluation and the cost of WATS service equivalent to the FTS traffic was computed. The sampled sites were selected to ensure a wide geographic dispersion, a large volume of FTS traffic and diversity of organizational missions. A simple comparision of FTS and WATS costs was not possible for several reasons. First, no historic FTS costs were available for specific locations or volume of traffic. Secondly, FTS cost is usage sensitive but distance insensitive. WATS costs are both usage and distance sensitive. Additionally, the FTS

costing algorithm was not available from GSA. Their publicized value of $.30 per minute daytime rate, or $.263 per minute all hours for the Army, for FY 84 was used as the FTS cost for comparative purposes. GSA will institute a new billing method starting 1 Oct 84. Their FY 85 projected value for the Army at a discounted rate is $.322 per minute for all traffic and was used in projecting future comparative costs.

V. ASSUMPTIONS.

A. Future impact of deregulation and divestiture on the telephone industry will affect the cost of all competing long distance carriers equally.

B. The GSA 20 percent traffic sample is statistically representative.

C. FTS traffic is consistent over time. Variations of Army traffic from week to week is negligible.

VI. FINDINGS AND CONCLUSIONS.

A. Thirty to 40 percent of all FTS calls are intrastate. GSA bills all calls at the $.30 per minute daytime rate regardless of destination. Intrastate WATS calls range between $.08 and $.25 per minute depending on the individual state tariffs. As a minumum, all intrastate FTS calls should be blocked at the switch and transparently routed over Foreign Exchange trunks, WATS trunks or WATS equivalent trunks depending on the economics of the particular location. This phenomenon was discovered early in the analysis and a letter was prepared by Comptroller for the DCSOPS' signature directing this action be taken by 7th Signal Command. The letter was transmitted on 22 Jun 84 (see annex E). This letter is, at best, only a partial solution to the problem.

B. There currently exists a split responsibility for telephone service. 7th Signal Command has responsibility for providing Direct Distance Dialing and WATS. The US Army Commercial Communications Office (USARCCO) has responsibility for providing Foreign Exchange (FX) trunks, AUTOVON and FTS. There is no single organization responsible for all telephone service. This has resulted in some duplication of services and cases of unnecessary expenditure of funds such as that pointed out in paragraph VI.A.

C. There are very few controls over telephone usage. This has both tacitly and implicitly resulted in a tremendous increase in telephone usage and, to some degree, abuse. The responsibility for controlling telephone usage lies within the discipline of both the user and the user's management structure. Very little control can be influenced and enforced by this command applying technical means. The use of Least Cost Routing and Automatic Message Accounting devices are two means of exerting some sort of technical control.

D. There will be sufficient savings generated by converting high volume user activities to WATS to be able to procure Least Cost Routing (LCR) devices for all locations where installation of digital switches is not imminent.

VII. RECOMMENDATIONS.

A. A single organization be made responsible for all telephone services.

B. Where feasible, block all intrastate FTS calls.

C. USAISC followup on directed actions in paragraph VI.A is required to ensure this program does not go uncontrolled.

D. DCSOPS, USARCCO and 7th Signal Command relook at possible telephone controls that may be instituted both in the near term and out years to reduce telephone abuse (e.g., use AMA data to provide call information to managers).

E. Immediately consider other alternatives to FTS. Before adding any new FTS service, other telephone services should be considered to ensure the most cost effective telephone service is provided.

F. Immediate action should be taken to convert the majority of telephone trunking at posts, camps and stations to WATS or WATS-equivalent service and apply these savings to purchasing LCR devices as outlined in the letter referenced in paragraph VI.A above.

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COST ANALYSIS OF FTS VERSUS COMPARATIVE WATS SERVICE AT SELECTED ARMY CONUS LOCATIONS

Prepared by:

HEADQUARTERS
US ARMY INFORMATION SYSTEMS COMMAND

CHAPTER 1

INTRODUCTION

1-1. Objective. The objective of this study is to compare the economic advantages and disadvantages of the Federal Telecommunications System (FTS) to Wide Area Telephone Service (WATS).

1-2. Background.

a. On 8 Apr 83, the Systems & Economic Analysis Division, Office of the Comptroller, US Army Communications Command (USACC), began a program evaluation of the Boston, MA, Defense Metropolitan Area Telephone System (DMATS). This study was completed in Nov 83 and was immediately followed by an evaluation of the St. Louis, MO, DMATS, which was completed in Mar 84. During both of these studies, as a topic of conversation, the DMATS management personnel insisted that FTS was a more expensive form of long distance telephone service than AT&T's WATS. This same perception was confirmed informally and unofficially by the USAF's Dayton, OH, DMATS staff.

b. USACC policy regarding installation and use of FTS has conformed to DOD policy, which was established by Congress. The House Appropriations Committee (HAC) stated in 1979, that "Expanded use of the FTS in lieu of commercial long distance telephone service could result in substantial savings and the HAC has directed DOD to proceed with FTS installation where cost effective." On 29 May 79, the Commanding General (CG) of USACC requested acceleration of the ongoing FTS Review Program to effect maximum savings through replacement of commercial long distance tolls with FTS where economically and operationally feasible. One year later, on 6 May 80, the CG, USACC, directed supporting activities to pursue FTS installation more aggressively if USACC was to be collectively successful in reducing commercial long distance and WATS costs. That directive stated that the Army would be able to communicate more effectively via FTS at a much lower cost than having the local base C-E officers procuring WATS and/or incurring long distance tolls. On 11 Sep 81, the US Army Commercial Communications Office (USARCCO) stated that the Army will expand direct commercial services via FTS in place of Direct Distance Dialing (DDD) tolls and WATS at greatly reduced costs. The CG, USACC, on 4 Feb 82, recommended FTS be expanded by encouraging FTS subscribers to place commercial calls via FTS in lieu of off-netting AUTOVON whenever possible and using FTS intra-Army when AUTOVON lines are busy. On 21 Oct 82, USARCCO stated that FTS was proven cost effective vis-a-vis Band 5 WATS and was therefore provided to St. Louis DMATS and Fort Huachuca, AZ to replace more costly Band 5 WATS.

c. As a result of this extensive correspondence, the field, from 7th Signal Command personnel to local operating facilities, perceived USACC policy to be that FTS is the directed long distance telephone service. Official USACC, and subsequently USAISC policy, has been to use FTS only if it is the most economical long distance telephone service at any given location.

d. Between the time of the congressional mandate to expand use of FTS in 1979 and late 1983, significant changes occurred within the telephone industry. Telecommunications Package (TELPAK), previously used to obtain long distance telephone service at a reduced cost, was eliminated. The telephone industry oligopoly was deregulated and divestiture of the AT&T Bell Operating Companies (BOC) was effective 1 Jan 84. The effect on telephone interLATA cost has been significant. A LATA is defined as a local assess transport area, i.e., an area within which a BOC may offer its exchange telecommunications and exchange access services.

e. As a response to this changing environment and the casual evidence that WATS may be more economical than FTS for Army interLATA communications in some, if not all, cases we initiated an indepth comparison of FTS and WATS costs. As an adjunct, we also began research into the availability of automated models which can analyze telephone traffic data for a particular location and recommend the most cost effective mix of telephone services.

1-3. Methodology.

a. The objective of this study is to compare, economically, FTS to WATS. A direct comparison of FTS costs to WATS costs was not possible for several reasons. First, no historic FTS costs were available which could be specifically associated with particular locations or volumes of traffic. Secondly, FTS cost is currently usage sensitive but distance insensitive. WATS cost is both usage and distance sensitive. Additionally, the FTS costing algorithm was not available from GSA. Therefore, we found it impossible to validate the GSA stated cost of FTS service. GSA's $.263 per minute (total usage) for FY 84 and their projected value of $.322 per minute (total usage) for FY 85 were used as the numbers for comparative purposes.

b. GSA will adopt to a measured service for costing purposes in FY 85 to reflect 24 hours usage , 7 days a week. Calls during the evening and nights will be discounted below the day rate. FTS network calls originating in the 34 largest cities in CONUS will be discounted below MCI's WATS rates; on all other routes the discount will be applied at the AT&T DDD rates. Billing will be based on the latest available quarter rather than the four quarter averages.

c. The procedure adopted to compare FTS cost to WATS cost was to cost FTS traffic using the WATS tariffs. A sample of FTS traffic was obtained from 10 sites within the continental United States (CONUS) and the cost of

WATS service equivalent to the FTS traffic was computed. The sampled sites were chosen with care to ensure a wide geographic dispersion, a large volume of FTS traffic and diversity of missions. This methodology required extensive use of an automated algorithm which sorted the sample of FTS traffic by destination prefix and then accumulated the traffic by equivalent WATS bands.

d. At every decision point, any advantage was allowed to accrue to FTS, i.e., this analysis represents worst case WATS vs best case FTS. The result of this tactic was to ensure that if WATS did appear more cost effective than FTS, sufficient cause existed to challenge the concept that FTS is always cheaper.

1-4. Assumptions. The following list represents assumptions of a general nature which are applied throughout this study. In several cases, an assumption was applied to a specific situation only. In those cases, the assumption is identified and discussed where it is used.

a. The future impact of deregulation and divestiture on the telephone industry will affect the cost of all competing long distance carriers equally.

b. Grade of Service (GOS) is P.05 (out) in the busy hour using Erlang B statistics for both WATS and FTS. P.05 is defined as a 5 percent probability of encountering an all-trunks-busy condition when dialing a number during the busy hour.

c. The GSA 20 percent traffic sample is statistically reasonable.

d. FTS traffic is stationary over time. Any variation from week to week is negligible.

1-5. Scope. This study has been limited to an economic comparison of FTS to WATS. WATS-equivalent services such as MCI and Sprint (or other competitive carriers that enter the market) may be evaluated as an addendum at a later date. Other types of long distance telephone services such as foreign exchange lines (FX) or AUTOVON are not being considered for inclusion in this study. However, this does not mean to imply that these options should be excluded from any economic analysis used to determine the most cost effective combination of telephone service.

CHAPTER 2

COST ANALYSIS

2-1. *Introduction.* A cost comparison of FTS vs WATS is provided in this chapter in summary form. A detailed presentation of FTS traffic costed as equivalent WATS traffic is presented in annex A of this study.

2-2. Costing Algorithm.

a. As discused in paragraph 1-3c, the methodology adopted required costing FTS traffic as equivalent WATS traffic. WATS cost is a function of total traffic volume, distance called and time of day of the call. The CONUS has been divided into 6 distance bands, 0 through 5 and 18 different rate steps.

b. Band 0 traffic represents traffic which is intrastate-interLATA. Band 5 traffic represents a maximum distance call within CONUS. Band 0 is typically priced at the lowest rate, Band 5 is priced at the highest rate and Bands 1 through 4 are priced at progressively higher intermediate rates.

c. The rate step applicable to each call is determined from the originating location and the band in which the destination is located. The cost of a WATS call is determined from a matrix of average hours per month per access line and the time of day the call is made vs the rate step.

d. The originating and destination location are used to identify the proper band. The originating location and band are used to identify the proper rate step. The average number of hours per FTS trunk per month is computed, and with the proper rate step and the time of day the call was made, the cost of a WATS call equivalent to an FTS call can be determined.

e. As is evident from the above discussion, the costing of FTS traffic at a rate equivalent to WATS is very complex. In an effort to simplify the procedure and to ensure that the FTS traffic is not inadvertently under costed, only two WATS bands were used. In one scenario, all traffic was costed at the Band 5 rate, thereby, maximizing the WATS expected cost. In the second scenario, all intrastate traffic was costed at the appropriate Band 0 rate and Band 5 was used for interstate FTS traffic. The third scenario used intrastate WATS (Band 0) and FTS rates for interstate traffic. The second and third scenarios usually resulted in reduced total cost but were not necessarily the minimum cost configuration. This procedure did ensure, however, that if the worst case cost for the equivalent WATS service was lower than the FTS cost, then the requirement to search for each optimum configuration at each post, camp and station

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	1270.133	1015.300	330.367	482.900	121.367	34.467
EVE	253.000	108.367	101.567	274.633	20.533	47.667
NITE	151.433	273.167	112.200	162.800	18.700	17.967

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	.22	.55	0.00	0.00	0.00	.08	.63	4.23	12.20	14.95	16.98	16.25
1-5	.22	.55	0.00	0.00	0.00	.05	.18	2.73	7.37	9.03	10.25	9.65
0	0.00	0.00	0.00	0.00	0.00	.03	.45	1.50	4.83	5.92	6.73	6.60

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	20.43	21.37	16.27	17.80	11.68	5.00	5.92	5.38	5.32	7.67	9.67	3.85
1-5	10.48	12.93	10.68	11.20	8.58	3.10	5.37	2.92	3.03	6.92	7.08	2.85
0	9.95	8.43	5.58	6.60	3.10	1.70	.55	2.47	2.28	.75	2.58	1.00

BUSY HOUR TRAFFIC

BAND 0-5 = 21.37 P05 TRUNK REQUIREMENT IS 27 ACTUAL P = .0427
BAND 1-5 = 12.93 P05 TRUNK REQUIREMENT IS 18 ACTUAL P = .0415
BAND 0 = 9.95 P05 TRUNK REQUIREMENT IS 15 ACTUAL P = .0355

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	120.54	37.25	27.27
BAND 1-5	110.24	41.82	32.49
BAND 0	94.68	16.87	10.10

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2007.88	477.10	201.29
BAND 1-5	1864.60	530.11	239.83
BAND 0	1823.76	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2448
BAND 1-5 = .2409
BAND 0 = .2797
AV 1-5&0 = .2538

ANNUAL WATS SAVINGS USING BAND 5 = 65545.84
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 32977.84
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= -20180.84

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	498.100	347.967	30.433	19.067	24.567	31.533
EVE	21.633	32.633	.367	.367	0.000	0.000
NITE	17.967	18.700	0.000	0.000	0.000	0.000

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	0.00	0.00	0.00	0.00	0.00	0.00	.02	.50	4.48	5.08	5.22	5.85
1-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.32	1.95	3.42	1.98	3.18
0	0.00	0.00	0.00	0.00	0.00	0.00	.02	.18	2.53	1.67	3.23	2.67

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	1.28	8.97	3.72	4.60	3.63	1.07	.20	.08	.67	.37	.07	0.00
1-5	.75	2.48	1.97	3.28	1.62	.48	.20	.08	.65	.02	.05	0.00
0	.53	6.48	1.75	1.32	2.02	.58	0.00	0.00	.02	.35	.02	0.00

BUSY HOUR TRAFFIC
BAND 0-5 = 8.97 P05 TRUNK REQUIREMENT IS 14 ACTUAL P = .0331
BAND 1-5 = 3.42 P05 TRUNK REQUIREMENT IS 7 ACTUAL P = .0363
BAND 0 = 6.48 P05 TRUNK REQUIREMENT IS 11 ACTUAL P = .0337

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	67.28	3.93	2.62
BAND 1-5	64.80	4.77	2.67
BAND 0	44.40	1.97	1.63

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1258.42	54.90	19.71
BAND 1-5	1216.69	66.61	20.10
BAND 0	288.20	0.00	0.00

AVERAGE COST PER MINUTE
BAND 0-5 = .3081
BAND 1-5 = .3080
BAND 0 = .1070
AV 1-5&0 = .2054

ANNUAL WATS SAVINGS USING BAND 5 = -33536.86
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 42901.55
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 59299.68

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	858.733	851.767	98.267	863.500	153.633	245.667
EVE	461.633	845.533	75.900	812.533	104.867	254.467
NITE	261.800	634.333	45.100	598.400	71.867	194.333

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	4.33	2.47	2.45	.02	.03	.55	.63	5.15	11.42	16.92	18.47	15.25
1-5	3.65	1.13	2.28	0.00	0.00	.33	.18	3.80	9.67	12.95	13.22	11.37
0	.68	1.33	.17	.02	.03	.22	.45	1.35	1.75	3.97	5.25	3.88

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	14.45	13.58	17.32	16.70	15.73	16.12	15.02	19.35	15.68	16.80	16.90	6.85
1-5	10.10	8.82	11.33	11.92	11.43	14.50	12.10	12.37	12.33	14.[illegible]0	14.68	.43
0	4.35	4.77	5.98	4.78	4.30	1.62	2.92	6.93	3.35	2.[illegible]0	2.22	.42

BUSY HOUR TRAFFIC

BAND 0-5 = 19.35   P05 TRUNK REQUIREMENT IS 25   ACTUAL P = .0409
BAND 1-5 = 14.68   P05 TRUNK REQUIREMENT IS 20   ACTUAL P = .0403
BAND 0 = 6.98   P05 TRUNK REQUIREMENT IS 11   ACTUAL P = .0472

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	122.86	102.20	72.23
BAND 1-5	110.64	104.67	77.20
BAND 0	78.07	41.97	23.80

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2079.90	1161.33	543.56
BAND 1-5	1906.48	1184.09	580.94
BAND 0	940.77	360.47	114.19

AVERAGE COST PER MINUTE

BAND 0-5 = .2140
BAND 1-5 = .2110
BAND 0 = .1684
AV 1-5&0 = .2019

ANNUAL WATS SAVINGS USING BAND 5 = 262458.26
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 326775.68
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 107746.32

APPENDIX I

COST COMPARISON BASED ON THE CURRENT FTS COST PER MONTH OF $0.263

ANNEX A

DETAILED COST ANALYSIS

APPENDIX I—COST COMPARISON BASED ON THE CURRENT FTS COST PER MINUTE OF $.263

APPENDIX II—COST COMPARISON BASED ON A PROJECTED FY 85 FTS COST PER MINUTE OF $.322

c. WATS is billed at one-tenth of a minute increments. FTS is billed at a full minute minimum. The result is that the typical WATS call is billed at an average of 24 seconds less duration than with FTS. This may represent a substantial savings for a large traffic volume. Any cost savings is in favor of WATS.

d. This study did not attempt to construct the optimum trunking to minimize WATS cost. All FTS traffic was costed under only three scenarios, the maximim cost of Band 5, WATS intrastate and FTS interstate and a combination of Band 0 and Band 5 WATS. The potential exists to customize WATS trunking to match local calling patterns. The result should reduce the WATS cost, perhaps significantly.

e. If telephone service was obtained through the competitive market, it is possible the costs developed in this study could be reduced.

4-3. Recommendations.

a. Consideration should be given to costing alternative telephone vendors, if not in toto, then on a location-by-location basis. The new GSA billing scheme will make FTS service even more expensive for the Army (approximately $5.3 million more in FY 85 than under their old billing system).

b. Least Cost Routing (LCR) devices should be procured through the Productivity Capital Investment Program (PCIP), AR 5-4; or Base-Level Commercial Equipment Program, DCA Cir 310-83-1. These LCR's should be located at major Army facilities that are not scheduled for new digital switches under the CONUS Modernization Program in the next 5-7 years. The new digital switches normally have self-contained LCR's as part of their hardware. In most instances, LCR's could be procured with the savings accrued primarily with intrastate traffic the first year by going to WATS service or WATS equivalent service.

c. Where feasible, immediately block all intrastate FTS calls in states where WATS is cheaper. Intrastate FTS calls account for 30-40 percent of the FTS service. This service can be provided by other means at a significant savings.

d. Place responsibility for all telephone service under one organization to ensure all alternatives are analyzed before selecting the optimum telephone mix. Commercially available software packages exist that will analyze telephone traffic and provide the optimum trunking requirements (FTS, WATS, MCI, SPRINT, etc.) and would be an invaluable tool to that organization.

e. Telephone calling patterns at each location should be periodically checked to ensure that proper trunking is provided within operational parameters. This will be a check to ensure the cost is optimized for the required service. Paragraph 4-3.d must occur for this to be implemented.

USARCCO. In order to be able to provide the most efficient and economical service, one organization should have total responsibility for providing all interLATA telephone service.

e. Analysis shows (annex A) that when directly comparing WATS with FTS at the current $.263 per minute and the projected $.322 per minute for FY 85, the following occurs:

(1) At $.263 for the 10 sites analyzed:

Total annual savings using Band 5 rates for all calls—$638K.
Total annual savings using Band 0 and Band 5 rates for Bands 1 through 5—$1,451K.
Total annual savings using Band 0 WATS and FTS interstate—$957K.

(2) At $.322 for the 10 sites analyzed:

Total annual savings using Band 5 rates for all calls—$2,252K.
Total annual savings using Band 0 and Band 5 rates for Bands 1 through 5—$3,065K.
Total annual savings using Band 0 WATS and FTS interstate—$1,490K.

As can be seen, the maximum investigated savings occurs if Band 0 is used for intrastate and Band 5 is used for all interstate calls. Further savings may occur if the interstate traffic were tailored to specific WATS Bands 1, 2, 3 or 4, which are cheaper than Band 5.

4-2. Other Considerations.

a. No attempt has been made to establish the absolute cost of FTS as compared to equivalent WATS. During the course of the study several facts emerged which will affect FTS and WATS cost and should be considered in the decisionmaking process but which are not of sufficient magnitude to change the conclusions and recommendations of this study. For example, as FTS was installed at certain locations, the command expected equivalent WATS trunking to be removed. This did not always occur. Therefore, the command is incurring the expense of maintaining WATS at less than optimum utilization. A single organization responsible for all interLATA service could have discovered and corrected this oversight.

b. When FTS trunks terminate at the BOC dial central office (DCO), the local USAISC agency incurs an access fee. Typically this fee is $50 or more per month per trunk and is not included in the analysis. The equivalent fee for WATS has been included in the cost computations. However, additional local access trunks (class A lines) may be needed to support off-net service if FTS was converted to WATS. This cost was not included but should approximate the assumed $50 per trunk cost of FTS. The result may be small bias in favor of FTS.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

4-1. Conclusions.

a. The telephone system basically lacks controls to ensure that the system is not abused. Until such time as controls are implemented the telephone bill may continue to escalate unchecked. It is recognized that controls lie with the telephone users and their management hierarchy. However, there are some things this command can do such as decreasing grade of service, installing Least Cost Routing and Automatic Message Accounting devices at all major telephone switches, and instituting a customer education program.

b. GSA is instituting a new billing system in FY 85. GSA will begin chargin for a 24-hour measured service, 7 days a week. Their service will be cheaper for those users making on-net calls within 34 identified major metropolitan areas. If a user goes off-net or is not located in one of the 34 metropolitan areas, the user will be charged at the AT&T DDD rates. Regardless of whether the user is charged at the AT&T DDD rate or a reduced rate, GSA will give a 12-14 percent discount. Since most of the Army activities are not located in the 34 metropolitan areas, or if they are, most of their calls are off-net; the Army can expect to be billed at the more expensive rate for the majority of its traffic. GSA verbally stated on 21 Jun 84 that the Army's future bills would be higher than present. The value of the Army staying with FTS service to the extent we are now committed should be reevaluted. The competitive nature of the telephone industry under deregulation and divestiture should be able to generally provide the same service at less cost than FTS.

c. Approximately 30 to 40 percent of all FTS calls at each location analyzed were intrastate. GSA bills their customers at a fixed rate of approximately $.263 per minute in FY 84 regardless of whether the call is intrastate or interstate. Current WATS interLATA intrastate rates vary by state but are typically less than FTS rates—in some cases as much as two-thirds less. The interstate savings are less dramatic but still significant under the current billing scheme. The difference will become even more significant when the new billing scheme takes effect 1 Oct 84. The average FTS rate for the Army will rise from $.263 per minute to $.322 per minute with a projected 88.8 million minutes of FTS use for the Army. This $.06 per minute differential equates to an increase of approximately $5.3 M for the Army which is directly attributable to GSA's changed billing procedures.

d. The USAISC organization does not lend itself to providing the most efficient telephone service. A portion of the responsibility for providing telephone service lies with 7th Signal Command and a portion lies with

average for total traffic for the second case. The model output also provides traffic summaries by band and day, night, and evening for comparative purposes. Other products include busy hour traffic and trunking required for P.05 (out) service.

g. Documentation of the model, to include flow chart, program and description of operation is provided at annex B.

CHAPTER 3

MODEL AIDED ANALYSIS

3-1. Introduction. As discussed in Methodology (paragraph 1-3), the procedure adopted by this study was to cost sample FTS traffic using WATS tariffs. The costing algorithm required to accomplish this methodology is quite complex (paragraph 2-2). In order to complete this study in a timely manner, a FORTRAN program was developed to implement the algorithm.

3-2. Model Summary.

a. In operation, the WATS costing model is required to aggregate FTS traffic data by geographic region by both orginating and destination location and by time of day within day, evening, and night distribution. After each call at each location has been properly accumulated, the appropriate cost rate is applied.

b. Raw data is provided by GSA as a 20 percent sample of all traffic placed on the FTS system. To simplify programing and reduce file space requirements, total traffic is estimated from calls made during a selected 7-day period.

c. Only rate Bands 0 and 5 are currently used by the costing routine and, as a result, the equivalent WATS costs developed may be higher than if band selection was optimized. However, all traffic is accumulated into the proper rate band to permit flexibility of future model enhancements.

d. One of the entering arguments for determining the appropriate WATS cost is average hours of traffic per trunk per month in the day, evening, and night categories. The number of trunks required are calculated from busy hour traffic. The model calculates mean busy hour traffic and then computes trunk requirements from the Erlang B equation using an iterative process.

e. The cost per minute of WATS can then be calculated and compared with the cost per minute of FTS. It should be noted that trunking and costing are accomplished for three cases only. The first case assumes that all traffic is to be carried by Band 5 trunking. The second case uses Band 0 trunks to carry intrastate traffic and Band 5 rates are used for interstate calls. The third case uses Band 0 WATS for intrastate traffic and FTS for interstate traffic using the $.263 per minute for the current structure and $.322 per minute for the projected rates in FY 85.

f. The model, in addition to computing cost per minute using Band 5 rates for all traffic (first case), Band 0 and Band 5 rates (second case) and Band 0 and FTS interstate rates (third case) computes a weighted

(3) Other factors were considered but not included in the analysis. These factors favor WATS—approximately $2,000K.

b. Projected FY 85 Cost Comparison:

(1) Annual savings if WATS would replace FTS at the 10 selected sites at the beginning of FY 85—$3,065K.

(2) Cost impact after optimization of WATS trunking—unknown but should favor WATS.

(3) Other factors were considered but not included in the analysis. These factors favor WATS—approximately $2,400K.

TABLE 2-2

SUMMARY OF FTS AND EQUIVALENT WATS ANNUAL COST SAVINGS BY LOCATION

Cost in Thousands

LOCATION	Bands 0&5	Band 5	WATS INTRASTATE FTS INTERSTATE
Fort Benning	$326.8	$262.5	$107.7
Bayonne	42.9	-33.5	59.3
Fort Knox	33.0	65.5	-20.2
Fort Sheridan	107.0	28.8	98.3
Sacramento AD	-12.7	-13.6	-5.9
Fort Dix	280.2	31.4	268.5
New Cumberland AD	43.3	-28.7	61.7
Fort Bragg	109.6	14.8	103.3
Fort Hood	482.3	308.1	238.4
Fort Huachuca	38.6	3.0	45.4
Savings FY 84	$1,451.0	$638.3	$956.5
FY 85	$3,065.0	$2,252.0	$1,490.0

e. This analysis has not included several considerations which will impact the cost comparison. In each case, inclusion of these considerations will increase the cost of FTS or reduce the cost of WATS. For example, WATS is billed at 0.1 minute increments while GSA bills FTS at the full minute rate even though a subscriber uses only a portion of a minute. Statistically, this will reduce the average call time by 24 seconds. Considering the volume of traffic in the Army, this represents approximately $2,000K in FY 84 and $2,400K in FY 85. As a second example, FTS trunks are normally assessed a local access charge by the BOC. This charge is typically $50 or more per month per trunk and is paid by the local agency. The charge has not been included as part of the total FTS cost but any local termination charge was included in the WATS rate. Also, when costing the FTS traffic as equivalent WATS, no attempt was made to minimize the WATS cost by optimizing the allocation of FTS traffic to take advantage of the most economical band rate.

2-4. Summary. This is a two-part conclusion. The first part addresses those FTS and WATS costs associated with FY 84. The second part addresses GSA projected FTS costs and estimated WATS costs for FY 85.

a. FY 84 Cost Comparison:

(1) Annual savings if WATS had been at the 10 selected sites vice FTS—$1,451K.

(2) Cost after optimization of WATS trunking/costs—unknown but should favor WATS.

TABLE 2-1

SUMMARY OF FTS SERVICE COSTED AS EQUIVALENT WATS SERVICE

Cost Per Minute

Location	Band 0[1]	Bands 1-5[2]	Bands 0&5[3]	Band 5[4]
Fort Benning	.168	.211	.202	.214
Bayonne	.107	.308	.205	.308
Fort Knox	.280	.241	.254	.245
Fort Sheridan	.140	.257	.214	.250
Sacramento AD	.285	.288	.286	.288
Fort Dix	.080	.258	.189	.255
New Cumberland AD	.160	.317	.217	.294
Fort Bragg	.138	.258	.209	.256
Fort Hood	.138	.213	.192	.217
Fort Huachuca	.164	.270	.236	.261

1 Intrastate traffic costed at Band 0 rate
2 Interstate traffic costed at Band 5 rate
3 A weighted average of Band 0 and Bands 1-5 traffic
4 All traffic costed at Band 5 rate

d. Table 2-2 displays total annual cost savings for the 10 selected sites developed from the WATS cost per minute data found in table 2-1 and the FTS rates, both current and projected for FY 85. The Bands 0&5 column and the Band 5 column present the total annual cost savings for each location equivalent to the Bands 0&5 column and the Band 5 column in table 2-1. The third column represents the cost savings when the FTS interstate traffic rate is combined with the WATS intrastate traffic (Band 0) rate. It should be pointed out that although the FTS trunking at the 10 sites represents approximately 25 percent of the total FTS trunking for the Army, it cannot be linearly extrapolated to obtain the total projected Army savings. Each site must be evaluated on its own individual merits.

was eliminated. If the results were mixed, then it would be obvious that an analysis would have to be done at each location on its own merits.

f. For additional details on the costing algorithm and the effect of the several different cost rates on the total cost, refer to annexes A and B.

2-3. Results.

a. Table 2-1 displays a summary of the results of applying the costing algorithm discussed above. The cost of WATS equivalent to the FTS traffic found at 10 selected locations is presented as cost per minute to facilitate comparison. When contacted, GSA claimed FTS costs the user $0.263 (full-time) per minute for FY 84 and projected $0.322 per minute (full-time) under the new billing procedure. Cost analyses were performed using the two full-time rates for comparative purposes.

b. In table 2-1, the cost listed in the Band 0 column represents intrastate traffic. Intrastate traffic reflects the tariffs of the individual states. Note that, in some cases, the intrastate rate forces the cost higher than the interstate rates. The Band 1-5 column represents interstate traffic. The Band 0 & 5 column figures are the weighted average of the Band 0 and Bands 1-5 (Band 5 rates) cost. Of the three costing scenarios addressed by this analysis, the Bands 0 & 5 total is typically less than the total cost found by computing all traffic at the Band 5 rate (Band 5 Column).

c. The column labeled Band 5 in table 2-1 displays all the FTS traffic costed at the Band 5 rate. Except in those cases where the individual state tariff is greater than the interstate Band 5 rate, this procedure should typically result in the maximum cost for equivalent WATS service.

ORIGINATING NXX = 380 Ft Sheridan, IL

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	870.833	582.267	223.300	453.567	161.333	0.000
EVE	66.000	106.333	50.600	121.367	17.233	0.000
NITE	164.267	85.800	22.367	89.933	7.333	0.000

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	.18	.05	0.00	.12	.02	.05	.18	5.20	9.67	13.25	13.25	12.20
1-5	.15	0.00	0.00	0.00	0.00	.05	.13	3.40	5.80	7.48	9.22	7.83
0	.03	.05	0.00	.12	.02	0.00	.05	1.80	3.87	5.77	4.03	4.37

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	10.53	11.73	11.18	13.50	9.02	4.52	3.62	2.95	1.83	.62	1.13	.07
1-5	6.18	7.50	7.18	8.08	5.45	3.93	3.25	2.27	1.40	.25	.97	.02
0	4.35	4.23	4.00	5.42	3.57	.58	.37	.68	.43	.37	.17	.05

BUSY HOUR TRAFFIC

BAND 0-5 = 13.50 P05 TRUNK REQUIREMENT IS 19 ACTUAL P = .0358
BAND 1-5 = 9.22 P05 TRUNK REQUIREMENT IS 14 ACTUAL P = .0383
BAND 0 = 5.77 P05 TRUNK REQUIREMENT IS 10 ACTUAL P = .0363

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	120.59	19.03	19.45
BAND 1-5	101.46	21.11	14.67
BAND 0	87.08	6.60	16.43

A-5

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1962.95	248.97	140.32
BAND 1-5	1702.69	273.79	105.80
BAND 0	918.57	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2498
BAND 1-5 = .2567
BAND 0 = .1390
AV 1-5&0 = .2138

ANNUAL WATS SAVINGS USING BAND 5 = 28800.20
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 106959.19
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 98275.90

ORIGINATING NXX = 461 SACRAMENTO AD, CA

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	343.567	52.433	17.600	6.967	0.000	214.867
EVE	5.500	0.000	0.000	0.000	0.000	3.667
NITE	29.133	3.300	5.133	2.567	0.000	72.600

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	0.00	0.00	0.00	0.00	0.00	.17	.75	3.07	4.60	3.78	4.87	3.73
1-5	0.00	0.00	0.00	0.00	0.00	.17	.75	2.53	2.03	1.65	2.28	1.73
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.53	2.57	2.13	2.58	2.00

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	2.85	4.13	2.28	1.33	1.30	.32	.08	.02	0.00	0.00	0.00	0.00
1-5	1.37	2.18	.92	.70	.40	.15	0.00	.02	0.00	0.00	0.00	0.00
0	1.48	1.95	1.37	.63	.90	.17	.08	0.00	0.00	0.00	0.00	0.00

BUSY HOUR TRAFFIC
BAND 0-5 = 4.87 P05 TRUNK REQUIREMENT IS 9 ACTUAL P = .0334
BAND 1-5 = 2.53 P05 TRUNK REQUIREMENT IS 6 ACTUAL P = .0296
BAND 0 = 2.58 P05 TRUNK REQUIREMENT IS 6 ACTUAL P = .0317

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	70.60	1.02	12.55
BAND 1-5	48.64	.61	13.93
BAND 0	57.26	.92	4.89

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1314.10	14.23	94.42
BAND 1-5	945.84	8.54	104.85
BAND 0	1052.59	0.00	0.00

AVERAGE COST PER MINUTE
BAND 0-5 = .2880
BAND 1-5 = .2877
BAND 0 = .2848
AV 1-5E0 = .2863

ANNUAL WATS SAVINGS USING BAND 5 = -13629.52
ANNUAL WATS SAVINGS USING BANDS 5 E 0 = -12683.40
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= -5932.66

ORIGINATING NXX = 494 Ft Dix , NJ

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	1500.033	1308.633	196.900	245.667	176.367	214.133
EVE	256.667	360.067	55.000	102.667	71.867	158.400
NITE	279.400	116.600	53.900	48.767	64.533	67.100

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	1.10	.60	0.00	.12	.23	.07	.45	2.88	11.52	23.45	20.60	19.85
1-5	.33	.58	0.00	0.00	.03	.05	.28	1.53	7.27	13.75	12.38	12.10
0	.77	.02	0.00	.12	.20	.02	.17	1.35	4.25	9.70	8.22	7.75

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	16.13	18.92	16.40	23.92	14.70	6.27	5.52	6.60	7.95	7.97	4.27	5.13
1-5	8.68	10.45	9.03	14.35	9.08	3.57	4.83	4.48	5.45	5.35	3.57	2.68
0	7.25	8.47	7.37	9.57	5.62	2.70	.68	2.12	2.50	2.62	.70	2.45

BUSY HOUR TRAFFIC

BAND 0-5 = 23.92 P05 TRUNK REQUIREMENT IS 30 ACTUAL P = .0392
BAND 1-5 = 14.35 P05 TRUNK REQUIREMENT IS 20 ACTUAL P = .0351
BAND 0 = 9.70 P05 TRUNK REQUIREMENT IS 14 ACTUAL P = .0493

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	121.39	33.49	21.01
BAND 1-5	107.09	37.40	17.55
BAND 0	107.15	18.33	19.96

A-7

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2059.01	439.59	158.10
BAND 1-5	1856.01	488.23	132.03
BAND 0	676.77	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2547
BAND 1-5 = .2580
BAND 0 = .0798
AV 1-5&0 = .1892

ANNUAL WATS SAVINGS USING BAND 5 = 31389.81
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 280238.26
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 268498.54

ORIGINATING NXX = 589 NEW CUMBERLAND AD, PA

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	769.267	235.400	66.367	42.900	31.900	81.767
EVE	19.067	2.200	.367	3.300	.367	4.400
NITE	42.900	3.300	0.000	0.000	0.000	.367

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	.03	0.00	0.00	0.00	0.00	0.00	.23	.85	5.00	7.15	6.65	5.18
1-5	0.00	0.00	0.00	0.00	0.00	0.00	.15	0.00	1.55	2.93	1.97	2.08
0	.03	0.00	0.00	0.00	0.00	0.00	.08	.85	3.45	4.22	4.68	3.10

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	5.83	6.37	8.33	6.38	4.23	.67	.17	.25	.27	.08	.02	0.00
1-5	2.57	2.30	2.75	3.02	1.67	.22	0.00	.10	.17	0.00	0.00	0.00
0	3.27	4.07	5.58	3.97	2.57	.45	.17	.15	.10	.08	.02	0.00

BUSY HOUR TRAFFIC

BAND 0-5 = 8.33 P05 TRUNK REQUIREMENT IS 13 ACTUAL P = .0378
BAND 1-5 = 3.02 P05 TRUNK REQUIREMENT IS 7 ACTUAL P = .0224
BAND 0 = 5.58 P05 TRUNK REQUIREMENT IS 10 ACTUAL P = .0314

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5.	94.43	2.28	3.58
BAND 1-5	65.48	1.52	.52
BAND 0	76.93	1.91	4.29

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1676.45	31.93	26.95
BAND 1-5	1228.11	21.23	3.94
BAND 0	760.42	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2936
BAND 1-5 = .3172
BAND 0 = .1599
AV 1-5&0 = .2169

ANNUAL WATS SAVINGS USING BAND 5 = -28748.70
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 43275.58
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 61711.94

ORIGINATING NXX = 675 FT BRAGG, NC

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	898.700	291.500	408.833	249.700	73.700	134.933
EVE	92.767	81.033	89.833	29.333	12.100	45.467
NITE	159.500	48.767	90.933	52.067	34.833	31.167

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	1.60	.53	.80	.15	.43	.53	1.27	1.55	8.15	11.38	10.57	8.92
1-5	1.12	.43	.57	.15	.28	.47	.60	.58	4.38	5.88	6.97	5.07
0	.48	.10	.23	0.00	.15	.07	.67	.97	3.77	5.50	3.60	3.85

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	9.35	11.28	11.58	11.67	10.62	2.22	3.30	2.07	2.65	1.83	1.90	1.40
1-5	6.05	6.47	6.85	6.07	4.93	1.80	2.22	1.38	2.00	1.00	1.70	.93
0	3.30	4.82	4.73	5.60	5.68	.42	1.08	.68	.65	.83	.20	.47

BUSY HOUR TRAFFIC

BAND 0-5 = 11.67 P05 TRUNK REQUIREMENT IS 17 ACTUAL P = .0349
BAND 1-5 = 6.97 P05 TRUNK REQUIREMENT IS 11 ACTUAL P = .0467
BAND 0 = 5.68 P05 TRUNK REQUIREMENT IS 10 ACTUAL P = .0340

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	E/E	NITE
BAND 0-5,	121.02	20.62	24.55
BAND 1-5	105.33	23.43	23.43
BAND 0	89.87	9.28	15.95

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2053.77	279.52	184.70
BAND 1-5	1831.16	314.52	176.34
BAND 0	918.45	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2557
BAND 1-5 = .2577
BAND 0 = .1384
AV 1-5&0 = .2091

ANNUAL WATS SAVINGS USING BAND 5 = 14846.35
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 109636.77
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 103293.05

ORIGINATING NXX = 747 FT HOOD, TX

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	1908.867	193.967	89.833	77 .900	705.100	1010.533
EVE	462.367	36.800	103.767	43'.933	777.333	919.600
NITE	276.467	84.3̣3	11.367	61̣.133	551.100	352.367

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	3.78	2.67	.05	1.83	.32	.27	1.92	12.47	22.13	25.15	23.05	22.57
1-5	3.73	2.67	.05	1.22	.25	.18	1.25	7.65	12.02	16.00	11.02	13.98
0	.05	0.00	0.00	.62	.07	.08	.67	4.82	10.12	9.15	12.03	8.58

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	21.35	24.02	25.60	27.22	21.83	14.72	18.08	18.75	22.32	19.98	12.47	9.88
1-5	13.77	14.50	14.40	17.70	12.75	11.30	14.07	16.60	20.18	14.72	10.32	9.37
0	7.58	9.52	11.20	9.52	9.08	3.42	4.02	2.15	2.13	5.27	2.15	.52

BUSY HOUR TRAFFIC
BAND 0-5 = 27.22 P05 TRUNK REQUIREMENT IS 33 ACTUAL P = .0441
BAND 1-5 = 20.18 P05 TRUNK REQUIREMENT IS 26 ACTUAL P = .0395
BAND 0 = 12.03 P05 TRUNK REQUIREMENT IS 17 ACTUAL P = .0415

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	142.07	84.60	57.14
BAND 1-5	106.90	89.59	61.90
BAND 0	112.29	27.20	16.26

A-10

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2282.38	959.28	417.21
BAND 1-5	1798.18	1013.97	451.90
BAND 0	251.00	0.00	0.00

AVERAGE COST PER MINUTE
BAND 0-5 = .2173
BAND 1-5 = .2126
BAND 0 = .1379
AV 1-5&0 = .1915

ANNUAL WATS SAVINGS USING BAND 5 = 308097.12
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 482287.19
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 238412.47

ORIGINATING NXX = 769 FT HUACHUCA, AZ

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	429.733	228.800	24.200	182.967	3.300	538.267
EVE	157.300	7.333	0.000	33.733	0.000	130.900
NITE	47.667	16.867	2.200	56.833	0.000	118.800

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	0.00	0.00	.02	0.00	.08	.03	.88	3.03	8.63	7.83	8.15	5.73
1-5	0.00	0.00	.02	0.00	0.00	.03	.82	2.28	6.67	5.85	6.30	3.60
0	0.00	0.00	0.00	0.00	.08	0.00	.07	.75	1.97	1.98	1.85	2.13

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	5.85	8.20	7.75	7.73	4.00	2.48	5.02	1.23	2.07	2.80	.33	.23
1-5	4.08	5.62	5.07	5.00	2.25	1.33	3.52	.48	1.07	.50	.02	0.0[illegible]
0	1.77	2.58	2.68	2.73	1.75	.15	1.50	.75	1.00	2.30	.32	.23

BUSY HOUR TRAFFIC

BAND 0-5 = 8.63 P05 TRUNK REQUIREMENT IS 13 ACTUAL P = .0449
BAND 1-5 = 6.67 P05 TRUNK REQUIREMENT IS 11 ACTUAL P = .0384
BAND 0 = 2.73 P05 TRUNK REQUIREMENT IS 6 ACTUAL P = .0385

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	108.25	25.33	18.64
BAND 1-5	88.87	15.63	17.70
BAND 0	71.62	26.22	7.94

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1872.56	338.08	140.29
BAND 1-5	1597.49	217.50	133.19
BAND 0	1038.46	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2609
BAND 1-5 = .2700
BAND 0 = .1636
AV 1-5&0 = .2359

ANNUAL WATS SAVINGS USING BAND 5 = 3040.72
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 38616.80
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 45417.67

```
TOTAL ANNUAL SAVINGS USING BAND 5 =     638263.22
TOTAL ANNUAL SAVINGS USING BANDS 0 & 5 =     1450985.47
TOTAL ANNUAL SAVINGS USING BAND 0 FOR INTRASTATE AND FTS FOR INTERSTATE =     956542.06
```

APPENDIX II

COST COMPARISON BASED ON A PROJECTED

FY 85 FTS COST PER MINUTE OF $0.322

ORIGINATING NXX = 256 FT. BENNING, GA

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	958.133	851.767	98.267	863.500	153.633	245.667
EVE	461.633	845.533	75.900	812.533	104.867	254.467
NITE	261.800	634.333	45.100	598.400	71.867	194.333

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	4.33	2.47	2.45	.02	.03	.55	.63	5.15	11.42	16.92	18.47	15.25
1-5	3.65	1.13	2.28	0.00	0.00	.33	.18	3.80	9.67	12.95	13.22	11.37
0	.68	1.33	.17	.02	.03	.22	.45	1.35	1.75	3.97	5.25	3.88

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	14.45	13.58	17.32	16.70	15.73	16.12	15.02	19.35	15.68	16.80	16.90	6.85
1-5	10.10	8.82	11.33	11.92	11.43	14.50	12.10	12.37	12.33	14.10	14.68	6.43
0	4.35	4.77	5.98	4.78	4.30	.62	2.92	6.98	3.35	2.70	2.22	.42

BUSY HOUR TRAFFIC

BAND 0-5 = 19.35 P05 TRUNK REQUIREMENT IS 25 ACTUAL P = .0409

BAND 1-5 = 14.68 P05 TRUNK REQUIREMENT IS 20 ACTUAL P = .0403

BAND 0 = 6.99 P05 TRUNK REQUIREMENT IS 11 ACTUAL P = .0472

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	122.86	102.20	72.23
BAND 1-5	110.64	104.67	77.20
BAND 0	78.17	41.97	23.80

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2079.90	1161.33	543.56
BAND 1-5	1906.48	1184.09	580.94
BAND 0	940.77	360.47	114.19

AVERAGE COST PER MINUTE

BAND 0-5 = .2140

BAND 1-5 = .2110

BAND 0 = .1684

AV 1-5&0 = .2019

ANNUAL WATS SAVINGS USING BAND 5 = 578183.78

ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 642501.20

ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 174956.76

ORIGINATING NXX = 339 BAYONNE, NJ

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	488.400	347.96	30.433	19.067	24.567	31.533
EVE	21.633	32.633	.367	.367	0.000	0.000
NITE	17.967	18.700	0.000	0.000	0.000	0.000

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	0.00	0.00	0.00	0.00	0.00	0.00	.02	.50	4.48	5.08	5.22	5.85
1-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.32	1.95	3.42	1.98	3.18
0	0.00	0.00	0.00	0.00	0.00	0.00	.02	.18	2.53	1.67	3.23	2.67

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	1.28	8.97	3.72	4.60	3.63	1.07	.20	.08	.67	.37	.07	0.00
1-5	.75	2.48	1.97	3.28	1.62	.48	.20	.08	.65	.02	.05	0.00
0	.53	6.48	1.75	1.32	2.02	.58	0.00	0.00	.02	.35	.02	0.00

BUSY HOUR TRAFFIC

BAND 0-5 = 8.97 P05 TRUNK REQUIREMENT IS 14 ACTUAL P = .0331
BAND 1-5 = 3.42 P05 TRUNK REQUIREMENT IS 7 ACTUAL P = .0363
BAND 0 = 6.48 P05 TRUNK REQUIREMENT IS 11 ACTUAL P = .0337

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	67.28	3.93	2.62
BAND 1-5	64.80	4.77	2.67
BAND 0	44.40	1.97	1.63

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1258.42	54.90	19.71
BAND 1-5	1216.69	66.51	20.10
BAND 0	288.20	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .3081
BAND 1-5 = .3080
BAND 0 = .1070
AV 1-5&0 = .2054

ANNUAL WATS SAVINGS USING BAND 5 = 10371.88
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 86810.30
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 81729.12

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	1270.133	1015.300	330.367	482.900	121.367	34.467
EVE	253.000	308.367	101.567	27 .633	20.533	47.667
NITE	151.433	273.16	112.200	16[illegible].800	18.700	17.967

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	.22	.55	0.00	0.00	0.00	.08	.63	4.23	12.20	14.95	16.98	16.25
1-5	.22	.55	0.00	0.00	0.00	.05	.18	2.73	7.37	9.03	10.25	9.65
0	0.00	0.00	0.00	0.00	0.00	.03	.45	1.50	4.83	5.92	6.73	6.60

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	20.43	21.37	16.77	17.80	11.68	5.00	5.92	5.38	5.32	7.67	9.67	3.85
1-5	10.48	12.93	10.68	11.20	8.58	3.10	5.37	2.92	3.03	6.92	7.08	2.85
0	9.95	8.43	5.58	6.60	3.10	1.90	.55	2.47	2.28	.75	2.58	1.00

BUSY HOUR TRAFFIC

BAND 0-5 = 21.37 P05 TRUNK REQUIREMENT IS 27 ACTUAL P = .0427
BAND 1-5 = 12.93 P05 TRUNK REQUIREMENT IS 18 ACTUAL P = .0415
BAND 0 = 9.95 P05 TRUNK REQUIREMENT IS 15 ACTUAL P = .0355

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	120.54	37.25	27.27
BAND 1-5	110.24	41.82	32.49
BAND 0	84.68	16.87	10.10

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2007.88	477.10	201.29
BAND 1-5	1864.60	530.11	239.83
BAND 0	1823.76	0.00	0.00

AVERAGE COST PER MINUTE
BAND 0-5 = .2448
BAND 1-5 = .2408
BAND 0 = .2797
AV 1-5&0 = .2538

ANNUAL WATS SAVINGS USING BAND 5 = 277799.99
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 245231.99
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 50954.74

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	870.831	582.267	223.300	453.567	161.333	0.000
EVE	66.000	106.333	50.600	121.367	17.233	0.000
NITE	164.267	85.800	22.367	89.833	7.333	0.000

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	.18	.05	0.00	.12	.02	.05	.18	5.20	9.67	13.25	13.25	12.20
1-5	.15	0.00	0.00	0.00	0.00	.05	.13	3.40	5.80	7.48	9.22	7.83
0	.03	.05	0.00	.12	.02	0.00	.05	1.80	3.87	5.77	4.03	4.37

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	10.53	11.73	11.18	13.50	9.02	4.52	3.62	2.95	1.83	.62	1.13	.07
1-5	6.18	7.50	7.18	8.08	5.45	3.93	3.25	2.27	1.40	.25	.97	.02
0	4.35	4.23	4.00	5.42	3.57	.58	.37	.68	.43	.37	.17	.05

BUSY HOUR TRAFFIC
BAND 0-5 = 13.50 P05 TRUNK REQUIREMENT IS 19 ACTUAL P = .0358
BAND 1-5 = 9.22 P05 TRUNK REQUIREMENT IS 14 ACTUAL P = .0383
BAND 0 = 5.77 P05 TRUNK REQUIREMENT IS 10 ACTUAL P = .0363

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	120.59	19.03	19.45
BAND 1-5	131.46	21.11	14.67
BAND 0	37.08	6.60	16.43

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1962.95	248.97	140.32
BAND 1-5	1702.69	273.79	105.80
BAND 0	918.57	0.00	0.00

AVERAGE COST PER MINUTE
BAND 0-5 = .2498
BAND 1-5 = .2567
BAND 0 = .1390
AV 1-580 = .2138

ANNUAL WATS SAVINGS USING BAND 5 = 157193.17
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 235352.16
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 145050.62

BAND	0	1	2	3	4	5
DAY	343.517	52.433	17.600	6.967	0.000	214.867
FVF	5.500	0.000	0.000	0.000	0.000	3.667
NITE	29.333	3.300	5.133	2.567	0.000	72.600

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	0.00	0.00	0.00	0.00	0.00	.17	.75	3.07	4.60	3.78	4.87	3.73
1-5	0.00	0.00	0.00	0.00	0.00	.17	.75	2.53	2.03	1.65	2.28	1.73
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.53	2.57	2.13	2.58	2.00

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	2.85	4.13	2.28	1.33	1.30	.32	.08	.02	0.00	0.00	0.00	0.00
1-5	1.37	2.18	.92	.70	.40	.15	0.00	.02	0.00	0.00	0.00	0.00
0	1.48	1.95	1.37	.63	.90	.17	.08	0.00	0.00	0.00	0.00	0.00

BUSY HOUR TRAFFIC
BAND 0-5 = 4.87 POS TRUNK REQUIREMENT IS 9 ACTUAL P = .0334
BAND 1-5 = 2.53 POS TRUNK REQUIREMENT IS 6 ACTUAL P = .0296
BAND 0 = 2.58 POS TRUNK REQUIREMENT IS 6 ACTUAL P = .0317

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	FVF	NITE
BAND 0-5,	70.60	1.02	12.55
BAND 1-5	48.64	.61	13.93
BAND 0	57.26	.92	4.89

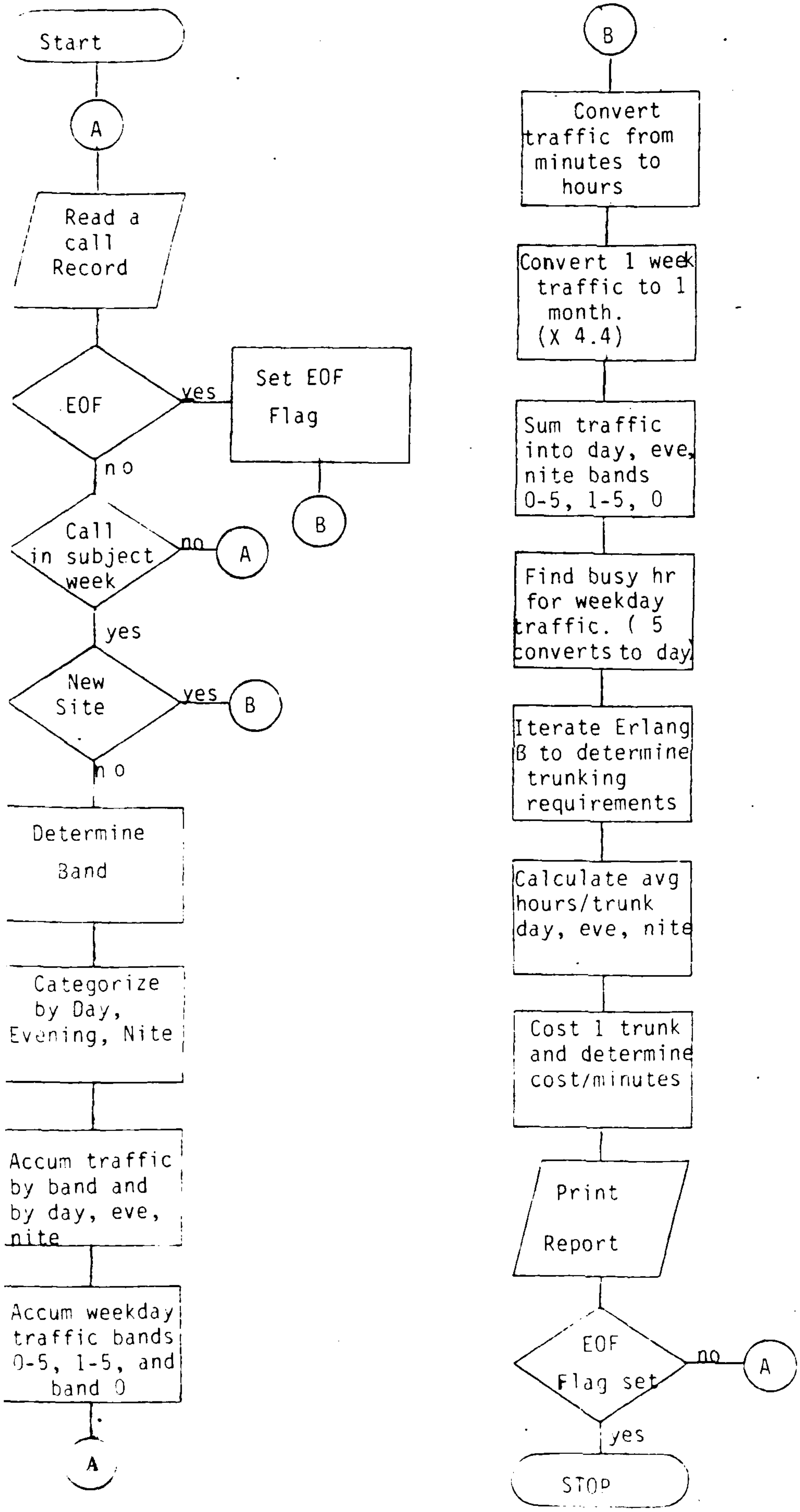
COST PER TRUNK PER MONTH

	DAY	FVF	NITE
BAND 0-5	1314.10	14.23	94.42
BAND 1-5	945.84	8.54	104.85
BAND 0	1052.59	0.00	0.00

AVERAGE COST PER MINUTE
BAND 0-5 = .2880
BAND 1-5 = .2877
BAND 0 = .2848
AV 1-5&0 = .2863

ANNUAL WATS SAVINGS USING BAND 5 = 18550.49
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 19496.62
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 10141.78

MODEL FLOW CHART



STATE/AREA	BASE/HOURLY COST
South Carolina	21.50
South Dakota	20.61
Tennessee	21.09
Texas (E)	20.86
Texas (S)	20.86
Texas (W)	20.86
Utah	21.50
Vermont	21.50
Virginia	21.50
Washington	21.50
West Virginia	21.50
Wisconsinn	20.86
Wyoming	20.86

TABLE B-1

BASE HOURLY COSTS BY STATE/AREA

STATE/AREA	BASE/HOURLY COST
Alabama	$21.09
Arizona	21.50
Arkansas	20.61
California (N)	21.50
California (S)	21.50
Colorado	20.86
Connecticut	21.50
Delaware	21.50
District of Columbia	21.50
Florida	21.50
Georgia	21.50
Idaho	21.50
Illinois (N)	20.61
Illinois (S)	20.61
Indiana	20.86
Iowa	20.40
Kansas	20.40
Kentucky	21.09
Louisiana	20.86
Maine	21.50
Maryland	21.50
Massachusetts	21.50
Michigan (N)	21.09
Michigan (S)	21.09
Minnesota	20.61
Mississippi	20.86
Missouri	20.61
Montana	21.09
Nebraska	20.40
Nevada	21.50
New Hampshire	21.50
New Jersey	21.50
New Mexico	21.09
New York (NE)	21.50
New York (SE)	21.50
New York (W)	21.50
North Carolina	21.50
North Dakota	20.61
Ohio (N)	21.09
Ohio (S)	21.09
Oklahoma	20.61
Oregon	21.50
Pennsylvania (E)	21.50
Pennsylvania (W)	21.50
Rhode Island	21.50

Costing Algorithm

WATS costs are based upon the monthly average hours of usage per trunk in the categories of day, evening, and night. Evening hours are charged at 65 percent of the daytime hourly rate and night hours are charged at 35 percent of the daytime hourly rate. Day and evening hours are costed on a sliding scale depending upon volume of traffic. The first 15 hours of day and evening traffic are costed at a base hourly rate, hours between 15.1 and 40 are costed at 89 percent of the base hourly rate, hours between 40.1 and 80 are costed at 78 percent of the base, and hours over 80 are costed at 66 percent of the base. All night hours are costed at 35 percent of the base hourly charge for daytime traffic. The derivation of formulas used in costing is as follows:

Let B = base hourly cost for daytime traffic
Let X = number of hours of monthly traffic
Let F = time of day factor (Day = 1, eve = .65, night = .35)

Four cases are developed with the formula to be used depending upon the size of X.

Case I. X is less than or equal to 15 or nighttime traffic.

$$\text{Cost} = F\ B\ X$$

Case II. X is greater than 15 and less than or equal to 40.

$$\begin{aligned}\text{Cost} &= F(15B + .89B(X-15)) \\ &= F\ B(1.65 + .89X)\end{aligned}$$

Case III. X is greater than 40 and less than or equal to 80.

$$\begin{aligned}\text{Cost} &= F(15B + 25(.89B) + .78B(X-40)) \\ &= F\ B(6.05 + .78X)\end{aligned}$$

Case IV. X is greater than 80.

$$\begin{aligned}\text{Cost} &= F(15B + 25(.89B) + 40(.78B) + .66B(X-80)) \\ &= F\ B(15.65 + .66X)\end{aligned}$$

Base hourly cost or B is determined in the program by a table (Table B-1) which maps the 58 areas described in the banding algorithm section of this annex into the base hourly costs for band 5 WATS.

Trunking Algorithm

Trunking requirements are determined by iterating the Erlang B formula. The formula is:

$$P = \frac{\dfrac{E^N}{N!}}{\displaystyle\sum_{X=0}^{N} \frac{E^X}{X!}}$$

Where:

P is grade of service (probability of blocking).
E is Erlangs of traffic in the busy hour.
N is the number of trunks required.

The algorithm starts with N = 1 and calculates P. If P is less than or equal to .05 then the number of trunks required is 1. If P is greater than .05, N is increased by 1 and P is recalculated. This process continues until P is less than or equal to .05. The value of N when P drops below .05 is the number of trunks required.

Call Banding Algorithm

For the purposes of banding, AT&T has divided CONUS into 58 areas (states and divisions thereof). Calls are banded by the model using a 58 X 58 matrix showing the minimum band required to carry a call from each area to itself and every other area. To use the table, one needs to know in which of the 58 areas the call originates and terminates. The originating and terminating area numbers are provided by a table which maps AT&T area codes and FTS NXX codes to a number from 1 to 58 corresponding to the 58 areas of the matrix. The row positioning on the matrix is determined by the NXX code of the originating location and the column position is determined by the NXX code of the terminating location (AT&T area code in the case of off-net calls).

Model Overview

1. The traffic engineering and WATS costing model was developed to facilitate a cost comparison of the Federal Telecommunications System (FTS) and AT&T's Wide Area Telephone System (WATS). The model reads a file which contains a 20 percent sample of detailed records of actual calls that were placed from CONUS Army installations over the FTS network and calculates the cost of routing the same traffic over WATS trunks. Input files are derived from Automatic Message Accounting (AMA) tapes that are supplied by GSA. To simplify programing, calls made during any full week of the month are considered. Monthly traffic is estimated by multiplying weekly traffic by 4.4 (4.4 = 31/7). Another simplifying feature of the model is that only bands 5 and 0 WATS trunks are considered for carrying traffic. Although this does not provide for optimum WATS costs, the WATS costs so developed were lower than corresponding FTS costs in most instances.

2. As call records are read, they are tested to see if they are in the subject week. If not, the record is ignored and another is read. Call records that are determined to be in the subject week are then checked to see which WATS band (band 0 if intrastate, band 1 through 5 if interstate) they would fall into. Traffic is then accumulated by band in the categories of day, evening, and night. Although only band 0 and band 5 trunks are utilized by the model, accumulation of traffic into all band categories provides for flexibility of future model enhancements. A description of the banding algorithm is found on page B-4 of this annex.

3. As stated in paragraph 2, traffic is accumulated by band in the categories of day, evening, and night. This allows for costing since costing is based on average hours of traffic per trunk in the day, evening, and night categories. In order to determine the number of trunks required to carry the traffic at a given Grade of Service (GOS), busy hour traffic must be known. To accommodate this requirement, weekday traffic is accumulated by the hour in which the calls are placed. The hourly traffic totals are then divided by 5 to convert to 1 day and finally, the highest hourly traffic total is selected as the busy hour load for use in determining trunking requirements. Trunking requirements are determined by iteration of the Erlang B formula. A description of the Erlang B formula and the iteration process is provided on page B-5 of this annex.

4. After the required number of trunks has been determined, average hours per trunk (day, evening, and night) is calculated and the cost of one trunk is derived. From the cost of one trunk, the cost per minute is calculated. The cost per minute of WATS can then be compared with the cost per minute of FTS. It should be noted that trunking and costing is done for two cases. The first case assumes that all traffic is to be carried by band 5 WATS. The second case uses band 0 WATS trunks to carry intrastate traffic and band 5 WATS for interstate calls. In addition to the cost per minute figures which are calculated for band 0 and band 5 in the second case, a weighted average cost per minute is also provided to allow direct comparison with FTS costs. Sample outputs of the model can be found in annex A.

ANNEX B

TRAFFIC ENGINEERING AND WATS COSTING MODEL

```
TOTAL ANNUAL SAVINGS USING BAND 5 =   2252201.61
TOTAL ANNUAL SAVINGS USING BANDS 0 & 5 =    3064923.86
TOTAL ANNUAL SAVINGS USING BAND 0 FOR INTRASTATE AND FTS FOR INTERSTATE =   1490300.42
```

ORIGINATING NXX = 769 FT HUACHUCA , AZ

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	429.733	228.800	24.200	182.967	3.300	538.267
EVE	157.300	7.333	0.000	33.733	0.000	130.900
NITE	47.667	16.867	2.200	56.833	0.000	118.800

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	0.00	0.00	.02	0.00	.08	.03	.88	3.03	8.63	7.83	8.15	5.73
1-5	0.00	0.00	.02	0.00	0.00	.03	.82	2.28	6.67	5.85	6.30	3.60
0	0.00	0.00	0.00	0.00	.08	0.00	.07	.75	1.97	1.98	1.85	2.13

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	5.85	8.20	7.75	7.73	4.00	2.48	5.02	1.23	2.07	2.80	.33	.23
1-5	4.08	5.62	5.07	5.00	2.25	1.33	3.52	.48	1.07	.50	.02	0.00
0	1.77	2.58	2.68	2.73	1.75	1.15	1.50	.75	1.00	2.30	.32	.23

BUSY HOUR TRAFFIC

BAND 0-5 = 8.63 P05 TRUNK REQUIREMENT IS 13 ACTUAL P = .0449
BAND 1-5 = 6.67 P05 TRUNK REQUIREMENT IS 11 ACTUAL P = .0384
BAND 0 = 2.73 P05 TRUNK REQUIREMENT IS 6 ACTUAL P = .0385

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	108.25	25.33	18.64
BAND 1-5	88.87	15.63	17.70
BAND 0	71.62	26.22	7.94

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1872.56	338.08	140.29
BAND 1-5	1597.49	217.50	133.19
BAND 0	1038.46	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2609
BAND 1-5 = .2700
BAND 0 = .1636
AV 1-5&0 = .2359

ANNUAL WATS SAVINGS USING BAND 5 = 87104.40
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 122680.47
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 72379.73

ORIGINATING NXX = 747 FT HOOD, TX

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	1908.667	193.967	89.833	77?.900	705.100	1010.533
EVE	462.367	96.800	103.767	431.933	777.333	919.600
NITE	276.467	84.333	11.367	610.133	551.100	352.367

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	3.78	2.67	.05	1.83	.32	.27	1.92	12.47	22.13	25.15	23.05	22.57
1-5	3.73	2.67	.05	1.22	.25	.18	1.25	7.65	12.02	16.00	11.02	13.98
0	.05	0.00	0.00	.62	.07	.08	.67	4.82	10.12	9.15	12.03	8.58

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	21.35	24.02	25.60	27.22	21.83	14.72	18.08	18.75	22.32	19.98	12.47	9.88
1-5	13.77	14.50	14.40	17.70	12.75	11.30	14.07	16.60	20.18	14.72	10.32	9.37
0	7.58	9.52	11.20	9.52	9.08	3.42	4.02	2.15	2.13	5.27	2.15	.52

BUSY HOUR TRAFFIC

BAND 0-5 = 27.22 P05 TRUNK REQUIREMENT IS 33 ACTUAL P = .0441
BAND 1-5 = 20.18 P05 TRUNK REQUIREMENT IS 26 ACTUAL P = .0395
BAND 0 = 12.03 P05 TRUNK REQUIREMENT IS 17 ACTUAL P = .0415

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	142.07	84.60	57.14
BAND 1-5	106.90	89.59	61.90
BAND 0	112.29	27.20	16.26

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2282.38	969.28	417.21
BAND 1-5	1798.18	1013.97	451.90
BAND 0	1251.00	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2173
BAND 1-5 = .2126
BAND 0 = .1379
AV 1-5&0 = .1915

ANNUAL WATS SAVINGS USING BAND 5 = 705954.89
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 880144.95
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 350886.77

ORIGINATING NXX = 675 Ft BRAGG, NC

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	898.700	291.500	408.833	249.700	73.700	134.933
EVE	92.767	81.033	89.833	29.333	12.100	45.467
NITE	159.500	48.767	90.933	52.067	34.833	31.167

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	1.60	.53	.80	.15	.43	.53	1.27	1.55	8.15	11.38	10.57	8.92
1-5	1.12	.43	.57	.15	.28	.47	.60	.58	4.38	5.88	6.97	5.07
0	.48	.10	.23	0.00	.15	.07	.67	.97	3.77	5.50	3.60	3.85

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	9.35	11.28	11.58	11.67	10.62	2.22	3.30	2.07	2.65	1.83	1.90	1.40
1-5	6.05	6.47	6.85	6.07	4.93	1.80	2.22	1.38	2.00	1.00	1.70	.93
0	3.30	4.82	4.73	5.60	5.68	.42	1.08	.68	.65	.83	.20	.47

BUSY HOUR TRAFFIC

BAND 0-5 = 11.67   P05 TRUNK REQUIREMENT IS 17   ACTUAL P = .0349
BAND 1-5 = 6.97   P05 TRUNK REQUIREMENT IS 11   ACTUAL P = .0467
BAND 0 = 5.68   P05 TRUNK REQUIREMENT IS 10   ACTUAL P = .0340

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	121.02	20.62	24.55
BAND 1-5	105.33	23.43	23.43
BAND 0	89.87	9.28	15.95

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2053.77	279.52	184.70
BAND 1-5	1831.16	314.52	176.34
BAND 0	918.45	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2557
BAND 1-5 = .2577
BAND 0 = .1384
AV 1-5&0 = .2091

ANNUAL WATS SAVINGS USING BAND 5 = 134859.43
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 229649.85
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 152186.11

ORIGINATING NXX = 589 NEW CUMBERLAND AD, PA

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	769.267	235.400	66.367	42.900	31.900	81.767
EVE	19.067	2.200	.367	3.300	.367	4.400
NITE	42.100	3.300	0.000	0.000	0.000	.367

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	.03	0.00	0.00	0.00	0.00	0.00	.23	.85	5.00	7.15	6.65	5.18
1-5	0.00	0.00	0.00	0.00	0.00	0.00	.15	0.00	1.55	2.93	1.97	2.08
0	.03	0.00	0.00	0.00	0.00	0.00	.08	.85	3.45	4.22	4.68	3.10

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	5.83	6.37	8.33	6.98	4.23	.67	.17	.25	.27	.08	.02	0.00
1-5	2.57	2.30	2.75	3.02	1.67	.22	0.00	.10	.17	0.00	0.00	0.00
0	3.27	4.07	5.58	3.97	2.57	.45	.17	.15	.10	.08	.02	0.00

BUSY HOUR TRAFFIC

BAND 0-5 = 8.33 P05 TRUNK REQUIREMENT IS 13 ACTUAL P = .0378
BAND 1-5 = 3.02 P05 TRUNK REQUIREMENT IS 7 ACTUAL P = .0224
BAND 0 = 5.58 P05 TRUNK REQUIREMENT IS 10 ACTUAL P = .0314

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5,	94.43	2.28	3.58
BAND 1-5	65.48	1.52	.52
BAND 0	76.93	1.91	4.29

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	1676.45	31.93	26.95
BAND 1-5	1228.11	21.23	3.94
BAND 0	760.42	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2936
BAND 1-5 = .3172
BAND 0 = .1599
AV 1-5&0 = .2169

ANNUAL WATS SAVINGS USING BAND 5 = 26639.56
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 98663.84
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 97022.74

ORIGINATING NXX = 484 Ft Dix, NJ

COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH

BAND	0	1	2	3	4	5
DAY	1500.033	1308.633	196.900	245.667	176.367	214.133
EVE	256.667	360.067	55.000	102.667	71.867	158.400
NITE	279.400	116.600	53.900	48.767	64.533	67.100

DAILY AVERAGE HOURS OF TRAFFIC BY HOUR

BAND	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
0-5	1.10	.60	0.00	.12	.23	.07	.45	2.88	11.52	23.45	20.60	19.85
1-5	.33	.58	0.00	0.00	.03	.05	.28	1.53	7.27	13.75	12.38	12.10
0	.77	.02	0.00	.12	.20	.02	.17	1.35	4.25	9.70	8.22	7.75

	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
0-5	16.13	18.92	16.40	23.92	14.70	6.27	5.52	6.60	7.95	7.97	4.27	5.13
1-5	8.88	10.45	9.03	14.35	9.08	3.57	4.83	4.48	5.45	5.35	3.57	2.68
0	7.25	8.47	7.37	9.57	5.62	2.70	.68	2.12	2.50	2.62	.70	2.45

BUSY HOUR TRAFFIC

BAND 0-5 = 23.92 P05 TRUNK REQUIREMENT IS 30 ACTUAL P = .0392
BAND 1-5 = 14.35 P05 TRUNK REQUIREMENT IS 20 ACTUAL P = .0351
BAND 0 = 9.70 P05 TRUNK REQUIREMENT IS 14 ACTUAL P = .0493

AVERAGE HOURS PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	121.39	33.49	21.01
BAND 1-5	107.09	37.40	17.55
BAND 0	107.15	18.33	19.96

COST PER TRUNK PER MONTH

	DAY	EVE	NITE
BAND 0-5	2059.01	439.59	158.10
BAND 1-5	1856.01	488.23	132.03
BAND 0	676.77	0.00	0.00

AVERAGE COST PER MINUTE

BAND 0-5 = .2547
BAND 1-5 = .2580
BAND 0 = .0798
AV 1-5&0 = .1892

ANNUAL WATS SAVINGS USING BAND 5 = 255544.02
ANNUAL WATS SAVINGS USING BANDS 5 & 0 = 504392.48
ANNUAL SAVINGS USING WATS FOR INTRASTATE AND FTS FOR INTERSTATE= 354992.06

SOURCE CODE LISTING

```
      PROGRAM WATSMOL(INPUT,OUTPUT,TAPE2,TAPE3,TAPE4,TAPE5,TAPE6)
      INTEGER DAY,DSTCODE,DSTNXX,CNCT,CALTIM,BANDTBL,AREATBL
      INTEGER TRUNKS
      REAL NITESUM,NIT1TO5,NITZERO
      DIMENSION BANDTBL(58,58),AREATBL(788),ISUM(6,3),TIME(6,3)
      DIMENSION HOURS(3),BEGCOST(58),COST(3),COST2(3),COST3(3)
      DIMENSION HRCNT(24),HRCNT2(24),HRCNT3(24)
      DIMENSION TRUNKS(3),ERLANG(3),CPM(3)
      DIMENSION HOURS2(3),HOURS3(3),P(3)
C
C     BANDTBL IS A MATRIX OF WATS BANDS BY STATE
C     AREATBL IS IS USED TO MAP AREA AND NXX CODES INTO STATE CODES
C     BEGCOST IS A TABLE OF BEGINNING RATES FOR THE 58 "STATES"
C
      REWIND 2
      REWIND 3
      REWIND 4
      REWIND 5
C
C     INITIALIZE VARIABLES
C
      SUMSAV1=0
      SUMSAV2=0
      SUMSAV3=0
      QUIT=0
      INXX=9999
      DO 20 I=1,24
      HRCNT(I)=0
      HRCNT2(I)=0
      HRCNT3(I)=0
   20 CONTINUE
      DO 40 I=1,6
      DO 40 J=1,3
      ISUM(I,J)=0
      TIME(I,J)=0
   40 CONTINUE
C
C     INTERACTIVE ENTRY OF BEGINNING DATE
C     PROGRAM USES ONE WEEK'S TRAFFIC BEGINNING WITH DATE ENTERED
C
      WRITE 60
   60 FORMAT(1H0,*ENTER DATE OF SATURDAY BEGINNING 1ST CLEAN WEEK*)
      READ *,IDAY
C
C     READ BEGINNING COST TABLE
C
      READ(2,80)(BEGCOST(I),I=1,58)
   80 FORMAT(F5.2)
C
C     READ BAND TABLE
C
      READ(3,100)((BANDTBL(I,J),I=1,58),J=1,58)
  100 FORMAT(58I1)
C
C     READ AREA CODE TABLE
C
      READ(4,120)(AREATBL(I),I=1,788)
  120 FORMAT(I2)
C
C     READ A DATA LINE
C
  140 READ(5,160)DAY,NXX,DSTCODE,DSTNXX,CNCT,CALTIM
  160 FORMAT(4X,I2,1X,I3,6X,I3,1X,I3,6X,I4,1X,I4)
```

```
      IF(EOF(5))180,200
180   QUIT=1
      GO TO 320
C
C     CHECK IF DAY IS IN SUBJECT WEEK
C
200   IF(DAY.LT.IDAY.OR.DAY.GT.(IDAY+6))GO TO 140
C
C     CHECK FOR NEW SITE
C
      IF(NXX.NE.INXX)GO TO 320
C
C     CHECK FOR VALID AREA CODE
C
      IF(DSTCODE.EQ.0)GO TO 220
      DSTCODE=DSTCODE-200
      IF(DSTCODE.LT.1.OR.DSTCODE.GT.788)GO TO 140
      J=AREATBL(DSTCODE)
      IF(J.EQ.98.OR.J.EQ.99)GO TO 140
      GO TO 240
220   DSTNXX=DSTNXX-200
      IF(DSTNXX.LT.1.OR.DSTNXX.GT.788)GO TO 140
      J=AREATBL(DSTNXX)
      IF(J.EQ.98.OR.J.EQ.99)GO TO 140
C
C     DETERMINE THE BAND
C
240   I=BANDTBL(I2,J)+1
C
C     DETERMINE THE RATE CATEGORY (DAY, EVENING, NIGHT)
C
      IF(DAY.EQ.IDAY)GO TO 260
      IF(CNCT.GE.2301.OR.CNCT.LE.0800)GO TO 260
      IF(CNCT.GE.1701.AND.CNCT.LE.2300)GO TO 280
      IF(DAY.EQ.(IDAY+1))GO TO 260
      J=1
      GO TO 300
260   J=3
      GO TO 300
280   J=2
300   CONTINUE
C
C     ACCUMULATE MINUTES OF TRAFFIC
C
      ISUM(I,J)=ISUM(I,J)+5*CALTIM
C
C     CHECK FOR SATURDAY OR SUNDAY
C
      IF(DAY.EQ.IDAY.OR.DAY.EQ.(IDAY+1))GO TO 140
C
C     DEVELOP INDEX FOR SUMMING WEEK DAY TRAFFIC BY HOUR
C
      INDEX=CNCT/100+1
      IF(INDEX.EQ.25)INDEX=1
C
C     ACCUMULATE HOURLY TRAFFIC FOR BANDS 0-5,1-5,AND 0
C
      HRCNT(INDEX)=HRCNT(INDEX)+5*CALTIM
      IF(I.EQ.1)GO TO 310
      HRCNT2(INDEX)=HRCNT2(INDEX)+5*CALTIM
      GO TO 140
310   HRCNT3(INDEX)=HRCNT3(INDEX)+5*CALTIM
      GO TO 140
```

```
C
C     SUMMARY ROUTINE
C     STEP 320 PRECLUDES SUMMARY IF THIS IS 1ST RECORD READ
C
C     MOVE TRAFFIC ARRAY (ISUM) TO TIME ARRAY AND CONVERT TO HOURS
C
  320 IF(INDX.EQ.9999)GO TO 780
      DO 340 I=1,6
      DO 340 J=1,3
      TIME(I,J)=ISUM(I,J)
      TIME(I,J)=TIME(I,J)/60.0
C
C     CONVERT TIME FROM WEEKS TO MONTHS
C     MULTIPLY BY 4.4 (31/7)
C
      TIME(I,J)=TIME(I,J)*4.4
  340 CONTINUE
C
C     INITIALIZE SUMMARY VARIABLES
C
      DAYSUM=0
      EVESUM=0
      NITESUM=0
C
C     SUMMARIZE TRAFFIC BY D,E,N  BANDS 0-5,1-5, AND 0
C
      DO 360 I=1,6
      DAYSUM=DAYSUM+TIME(I,1)
      EVESUM=EVESUM+TIME(I,2)
      NITESUM=NITESUM+TIME(I,3)
  360 CONTINUE
      DAY1TO5=DAYSUM-TIME(1,1)
      EVE1TO5=EVESUM-TIME(1,2)
      NIT1TO5=NITESUM-TIME(1,3)
      DAYZERO=TIME(1,1)
      EVEZERO=TIME(1,2)
      NITZERO=TIME(1,3)
C
C
C     FIND BUSY HOUR TRAFFIC BANDS 0-5,1-5,AND 0
C
      ERLANG(1)=0
      ERLANG(2)=0
      ERLANG(3)=0
      DO 380 I=1,24
C
C     DIVISION BY 300 CONVERTS MINUTES TO HOURS AND
C     AVERAGES THE 5-DAY WEEK
C
      HRCNT(I)=HRCNT(I)/300.0
      HRCNT2(I)=HRCNT2(I)/300.0
      HRCNT3(I)=HRCNT3(I)/300.0
      ERLANG(1)=AMAX1(ERLANG(1),HRCNT(I))
      ERLANG(2)=AMAX1(ERLANG(2),HRCNT2(I))
      ERLANG(3)=AMAX1(ERLANG(3),HRCNT3(I))
  380 CONTINUE
C
C     DETERMINE TRUNKING REQUIREMENTS BY ITERATING ERLANG B FORMULA
C
      DO 440 I=1,3
      IF(ERLANG(I).EQ.0)GO TO 432
      N=1
  400 TOP=ERLANG(I)**N/FACT(N)
```

```
      BOTTOM=0
      N2=N+
      DO 420 J=1,N2
      BOTTOM=BOTTOM+(ERLANG(I)**(J-1))/FACT(J-1)
 420  CONTINUE
      P(I)=TOP/BOTTOM
      IF(P(I).LE.0.05)GO TO 435
      N=N+1
      GO TO 400
 432  TRUNKS(I)=1
      GO TO 440
 435  TRUNKS(I)=N
 440  CONTINUE
C
C     DETERMINE AVG HOURS/TRUNK (DAY, EVENING, NIGHT)
C     FOR BANDS 0-5, 1-5, AND 0 AND DO THE COSTING
C  THE 4.4 FACTOR CONVERTS WEEKLY TRAFFIC TO MONTHLY (31/7)
C
      HOURS(1)=DAYSUM/TRUNKS(1)
      HOURS(2)=EVESUM/TRUNKS(1)
      HOURS(3)=NITESUM/TRUNKS(1)
      B=BEGCOST(I2)
      CALL COSTER(HOURS,B,COST,CPM(1))
      HOURS2(1)=DAY1TO5/TRUNKS(2)
      HOURS2(2)=EVE1TO5 TRUNKS(2)
      HOURS2(3)=NIT1TO5/TRUNKS(2)
      CALL COSTER(HOURS2,B,COST2,CPM(2))
      HOURS3(1)=DAYZERO/TRUNKS(3)
      HOURS3(2)=EVEZERO/TRUNKS(3)
      HOURS3(3)=NITZERO/TRUNKS(3)
C
C     BAND 0 COSTING IS NOT AUTOMATED
C     COSTS ARE ENTERED INTERACTIVELY
C
      WRITE 450,INXX
 450  FORMAT(1H1,*FOR ORIGINATING NXX CODE*,1X,I3)
      WRITE 460,(HOURS3(I),I=1,3)
 460  FORMAT(1X,*AVERAGE HOURS OF USAGE/TRUNK FOR BAND 0*/
     11X,*DAY, EVENING, AND NIGHT IS *,2X,3(F8.2,2X))
      WRITE 480
 480  FORMAT(1H0,1X,*PLEASE ENTER BAND 0 COSTS*/
     11X,*DAY, EVENING, AND NIGHT*/)
      READ *,(COST3(I),I=1,3)
      WRITE 485
 485  FORMAT(1H0,*ENTER THE BAND 0 ACCESS CHARGE*/)
      READ *,ACCESS
      TOPO=COST3(1)+COST3(2)+COST3(3)
      BOTTOMO=60*(HOURS3(1)+HOURS3(2)+HOURS3(3))
      CPM(3)=(TOPO+ACCESS)/BOTTOMO
      BOTMAVG=0
      TOPAVG=0
      DO 490 I=1,3
      BOTMAVG=BOTMAVG+60.0*HOURS2(I)*TRUNKS(2)
      BOTMAVG=BOTMAVG+60.0*HOURS3(I)*TRUNKS(3)
      TOPAVG=TOPAVG+COST2(I)*TRUNKS(2)
      TOPAVG=TOPAVG+COST3(I)*TRUNKS(3)
 490  CONTINUE
      TOPAVG=TOPAVG+ACCESS*TRUNKS(3)+31.65*TRUNKS(2)
      CPMAVG=TOPAVG/BOTMAVG
C
C     DETERMINE COST DIFFERENTIAL BETWEEN FTS AND WATS
C
      TOTHRS=0
```

```
      DO 495 I=1,6
      DO 495 J=1,3
      TOTHRS=TOTHRS+TIME(I,J)
      IF(TOTHRS.LT.100.0)GO TO 776
  495 CONTINUE
      SAVE1=-(CPM(1)-.263)*TOTHRS*12*60
      SAVE2=-(CPMAVG-.263)*TOTHRS*12*60
      SAVE3=-(CPM(3)-.263)*(TIME(1,1)+TIME(1,2)+TIME(1,3))*720
      SUMSAV1=SUMSAV1+SAVE1
      SUMSAV2=SUMSAV2+SAVE2
      SUMSAV3=SUMSAV3+SAVE3
C
C     PRINT REPORT
C
      WRITE(6,500)INXX
  500 FORMAT(1H1,*ORIGINATING NXX = *,1X,I3)
      WRITE(6,520)((TIME(I,J),I=1,6),J=1,3)
  520 FORMAT(1H0,1X,*COMPUTED TOTAL HOURS OF TRAFFIC PER MONTH*/
     11X,*BAND*,7X,*0*,10X,*1*,10X,*2*,10X,*3*,10X,*4*,10X,*5*/
     21X,*DAY*,6(3X,F8.3)/
     31X,*EVE*,6(3X,F8.3)/
     41X,*NITE*,2X,6(F8.3,3X))
      WRITE(6,540)(HRCNT(I),I=1,12)
  540 FORMAT(1H0,1X,*DAILY AVERAGE HOURS OF TRAFFIC BY HOUR*/
     11X,*BAND*,4X,*0-1*,4X,*1-2*,4X,*2-3*,4X,*3-4*,4X,*4-5*,4X,*5-6*
     24X,*6-7*,4X,*7-8*,4X,*8-9*,3X,*9-10*,2X,*10-11*,2X,*11-12*/
     31X,*0-5*,3X,12(F5.2,2X))
      WRITE(6,545)(HRCNT2(I),I=1,12)
  545 FORMAT(1X,*1-5*,3X,12(F5.2,2X))
      WRITE(6,550)(HRCNT3(I),I=1,12)
  550 FORMAT(2X,*0*,4X,12(F5.2,2X))
      WRITE(6,560)(HRCNT(I),I=13,24)
  560 FORMAT(1H0,6X,*12-13*,2X,*13-14*,2X,*14-15*,2X,*15-16*,2X
     1*16-17*,2X,*17-18*,2X,*18-19*,2X,*19-20*,2X,*20-21*,2X
     2*21-22*,2X,*22-23*,2X,*23-24*/
     31X,*0-5*,3X,12(F5.2,2X))
      WRITE(6,565)(HRCNT2(I),I=13,24)
  565 FORMAT(1X,*1-5*,3X,12(F5.2,2X))
      WRITE(6,570)(HRCNT3(I),I=13,24)
  570 FORMAT(2X,*0*,4X,12(F5.2,2X))
      WRITE(6,580)ERLANG(1),TRUNKS(1),P(1)
  580 FORMAT(1H0,1X,*BUSY HOUR TRAFFIC*/1X,*BAND 0-5 =*1X,F5.2,
     13X,*P05 TRUNK REQUIREMENT IS*,1X,I2,5X,*ACTUAL P =*,1X,F5.4)
      WRITE(6,600)ERLANG(2),TRUNKS(2),P(2)
  600 FORMAT(1X,*BAND 1-5 =*,1X,F5.2,3X,*P05 TRUNK REQUIREMENT IS*
     11X,I2,5X,*ACTUAL P =*,1X,F5.4)
      WRITE(6,620)ERLANG(3),TRUNKS(3),P(3)
  620 FORMAT(1X,*BAND  0  =*,1X,F5.2,3X,*P05 TRUNK REQUIREMENT IS*
     11X,I2,5X,*ACTUAL P =*,1X,F5.4)
      WRITE(6,640)(HOURS(I),I=1,3)
  640 FORMAT(1H0,*AVERAGE HOURS PER TRUNK PER MONTH*/
     13X,*              DAY       EVE        NITE*/
     21X,*BAND 0-5,*2X,3(F6.2,3X))
      WRITE(6,660)(HOURS2(I),I=1,3)
  660 FORMAT(1X,*BAND 1-5*,3X,3(F6.2,3X))
      WRITE(6,680)(HOURS3(I),I=1,3)
  680 FORMAT(1X,*BAND  0*,4X,3(F6.2,3X))
      WRITE(6,700)(COST(I),I=1,3)
  700 FORMAT(1H0,*COST PER TRUNK PER MONTH*/
     116X,*DAY          EVE          NITE*/
     21X,*BAND 0-5*,3X,3(F8.2,3X))
      WRITE(6,720)(COST2(I),I=1,3)
  720 FORMAT(1X,*BAND 1-5*,3X,3(F8.2,3X))
```

```
      WRITE(6,740)(COST3(I),I=1,3)
740   FORMAT(1X,*BAND  0*,4X,3(F8.2,3X))
      WRITE(6,760)(CPM(I),I=1,3)
760   FORMAT(1H0,*AVERAGE COST PER MINUTE*/
     11X,*BAND 0-5 =*,2X,F6.4/
     21X,*BAND 1-5 =*,2X,F6.4/
     31X,*BAND  0  =*,2X,F6.4)
      WRITE(6,770)CPMAVG
770   FORMAT(1X,*AV 1-5&0 =*,2X,F6.4)
      WRITE(6,775)SAVE1,SAVE2,SAVE3
775   FORMAT(1H0,1X,*ANNUAL WATS SAVINGS USING BAND 5 =*
     1 1X,F10.2/
     2 1X,*ANNUAL WATS SAVINGS USING BANDS 5 & 0 =*
     3 1X,F10.2/
     4 1X,*ANNUAL SAVINGS USING WATS FOR INTRASTATE*
     5 1X,*AND FTS FOR INTERSTATE=*,1X,F10.2)
776   IF(QUIT.EQ.1)GO TO 999
780   CONTINUE
      DO 800 I=1,6
      DO 800 J=1,3
      TIME(I,J)=0
800   ISUM(I,J)=0
      DO 820 I=1,24
      HRCNT(I)=0
      HRCNT2(I)=0
820   HRCNT3(I)=0
      DO 840 I=1,3
      HOURS(I)=0
      HOURS2(I)=0
      HOURS3(I)=0
840   CONTINUE
      INXX=NXX
      JNXX=INXX-200
      IF(JNXX.LT.1.OR.JNXX.GT.788)GO TO 140
      I2=AREATBL(JNXX)
      IF(I2.EQ.98.OR.I2.EQ.99)GO TO 140
      GO TO 200
C
C     SUMMARY OF COST DIFFERENTIAL FOR ALL SITES
C
999   WRITE(6,1000)SUMSAV1,SUMSAV2,SUMSAV3
1000  FORMAT(1H1,1X,*TOTAL ANNUAL SAVINGS USING BAND 5 =*
     1 1X,F12.2/
     2 1X,*TOTAL ANNUAL SAVINGS USING BANDS 0 & 5 =*
     3 1X,F12.2/
     4 1X,*TOTAL ANNUAL SAVINGS USING BAND 0 FOR INTRASTATE*
     5 1X,*AND FTS FOR INTERSTATE =*,1X,F12.2)
      ENDFILE 6
      STOP
      END
C
C     SUBROUTINE TO FIND COST OF WATS
C
      SUBROUTINE COSTER(HOURS,B,COST,CPM)
      DIMENSION HOURS(3),COST(3)
      TCOST=0
      DO 910 I=1,3
      IF(I.EQ.1)FACTOR=1
      IF(I.EQ.2)FACTOR=.65
      IF(I.EQ.3)FACTOR=.35
      IF(I.EQ.3)GO TO 920
      IF(HOURS(I).LE.15.)GO TO 920
      IF(HOURS(I).LE.40.)GO TO 930
```

```
      IF(HOURS(I).LE.80.)GO TO 940
      COST( )=B*FACTOR*(15.65+0.66*HOURS(I))
      GO TO 950
920   COST(I)=B*FACTOR*HOURS(I)
      GO TO 950
930   COST(I)=B*FACTOR*(1.65+0.89*HOURS(I))
      GO TO 950
940   COST(I)=B*FACTOR*(6.05+0.78*HOURS(I')
950   TCOST=TCOST+COST( )
910   CONTINUE
      TIME=0
      DO 960 I=1,3
960   TIME=TIME+60.0*HOURS(I)
      CPM=(TCOST+31.65)/TIME
      RETURN
      END
C
C     ROUTINE TO FIND THE FACTORIAL OF A NUMBER
C
      FUNCTION FACT(N)
      IN=N
      FACT=1
      IF(IN.EQ.1.OR.IN.EQ.0)GO TO 970
980   FACT=FACT*IN
      IN=IN-1
      IF(IN.NE.1)GO TO 980
970   CONTINUE
      RETURN
      END
```

AMA RECORDED MESSAGE REPORT

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RUN DATE 07/27/8

MONTH	DAY	ORIG FTS NXX	ORIG FTS EXT	DEST AREA CODE	DEST NXX	DEST EXT	CONNECT TIME	LENGTH OF CALL	CITY CODE
1	[illegible]	[illegible]	1[illegible]7	213	205	5512	1033	0004	058
	EXT SUBTOTAL			1 CALLS FOR		4 MINUTES			
[illegible]	[illegible]	[illegible]	[illegible]	415	965	6570	1354	0002	058
	EXT SUBTOTAL			1 CALLS FOR		2 MINUTES			
1	1	[illegible]	1071	212	429	6494	1357	0001	058
	EXT SUBTOTAL			1 CALLS FOR		1 MINUTES			
1	[illegible]	[illegible]	1223	206	247	1497	0953	0001	058
	EXT SUBTOTAL			1 CALLS FOR		1 MINUTES			
1	[illegible]	[illegible]	1229	206	567	7662	1402	0001	058
1	1	273	1229	502	244	8371	1256	0002	058
	EXT SUBTOTAL			2 CALLS FOR		[illegible] MINUTES			
1	[illegible]	273	1267	213	305	3659	1213	0003	058
	EXT SUBTOTAL			1 CALLS FOR		3 MINUTES			
1	[illegible]	273	1305	408	742	7540	0942	0001	058
1	1[illegible]	273	1305	213	577	9318	1000	0005	058
1	1[illegible]	273	1305	213	354	2026	1043	0004	058
	EXT SUBTOTAL			3 CALLS FOR		10 MINUTES			
1	1[illegible]	273	1311	213	577	9313	1404	0025	058
	EXT SUBTOTAL			1 CALLS FOR		25 MINUTES			

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RUN DATE 03/27/8

[illegible] DEPARTMENT OF ARMY
[illegible] DEPARTMENT OF ARMY
[illegible] CTL

MONTH	DAY	ORIG FTS NXX	ORIG FTS EXT	DEST AREA CODE	DEST NXX	DEST EXT	CONNECT TIME	LENGTH OF CALL	CITY CODE
1	[illegible]	275	1337	201	532	3491	1041	0002	058
	EXT SUBTOTAL			1 CALLS FOR		2 MINUTES			
1	1[illegible]	273	1373	317	230	3131	0806	0001	058
	EXT SUBTOTAL			1 CALLS FOR		1 MINUTES			
1	1[illegible]	273	1374	317	230	3131	0806	0005	058
	EXT SUBTOTAL			1 CALLS FOR		5 MINUTES			
1	[illegible]	[illegible]	1412	202	558	9616	1043	0001	058
	EXT SUBTOTAL			1 CALLS FOR		1 MINUTES			
1	[illegible]	[illegible]	1422	213	522	3525	1045	[illegible]	058
	EXT SUBTOTAL			1 CALLS FOR		[illegible] MINUTES			
1	[illegible]	[illegible]	1457	201	544	3102	1329	0013	058
	EXT SUBTOTAL			1 CALLS FOR		12 MINUTES			
1	1	[illegible]	1461	[illegible]	[illegible]	7001	0737	0001	058
	EXT SUBTOTAL			1 CALLS FOR		1 MINUTES			
1	[illegible]	[illegible]	[illegible]	404	[illegible]	4272	0937	[illegible]	[illegible]
	EXT SUBTOTAL			1 CALLS FOR		2 MINUTES			
1	[illegible]	[illegible]	17[illegible]	213	[illegible]	5454	1325	[illegible]	058
	EXT SUBTOTAL			1 CALLS FOR		[illegible] MINUTES			

AMA RECORDED MESSAGE REPORT

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		DIAL TIME		DEST NPA CODE	DEST NXX	DEST EXT	CONNECT TIME	LENGTH OF CALL	CITY CODE
1	[illegible]	1709		11[illegible]	[illegible]	5119	1339	001[illegible]	[illegible]
			1	CALLS FOR		1[illegible] MINUTES			
1	[illegible]	1717		117	5?4	4?01	1453	0001	0??
			1	CALLS FOR		1 MINUTES			
1	[illegible]	17[illegible]		?17	[illegible]	2477	1009	[illegible]	[illegible]
			1	CALLS FOR		[illegible] MINUTES			
1	[illegible]	19[illegible]		20?	577	2552	1353	0001	[illegible]
			1	CALLS FOR		1 MINUTES			
1	[illegible]	1926		213	674	47[illegible]	1441	0003	[illegible]
			1	CALLS FOR		3 MINUTES			
1	[illegible]	1933		213	305	5?07	1332	0001	[illegible]
			1	CALLS FOR		1 MINUTES			
1	[illegible]	1943		213	305	5904	1025	000[illegible]	[illegible]
1	[illegible]	1943		21[illegible]	305	4?13	1021	000[illegible]	[illegible]
			2	CALLS FOR		[illegible] MINUTES			
1	[illegible]	1947		213	305	5?1[illegible]	0939	001?	[illegible]
			1	CALLS FOR		19 MINUTES			
1	[illegible]	1949		215	305	5429	1435	001[illegible]	[illegible]
			1	CALLS FOR		15 MINUTES			

AMA RECORDED MESSAGE REPORT

PAGE NO. 0015
RUN DATE 03/27/8

ANNEX C

REFERENCES

1. AR 11-28, Economic Analysis and Program Evaluation for Resource Management, 2 Dec 75.

2. DOD Instruction 7041.3, Economic Analysis and Program Evaluation for Resource Management, 2 Dec 75.

3. GSA Automatic Message Accounting tapes for the months of Dec 83 and Jan 84.

4. FY 80 House Appropriations Committee Report; Extract of communications appropriations report.

5. Message, CC-CG, 291740Z Nov 79, subject: Federal Telecommunications System (FTS) Implementation.

6. Message, CCA-DS, 062243Z May 80, subject: Federal Telecommunications System (FTS) Utilization.

7. Message, CCA-DS, 111510Z Sep 81, subject: Maximizing Utilization of the Federal Telecommunications System (FTS).

8. Message, CC-CG, 041223Z Feb 82, subject: AUTOVON Grade of Service (GOS) Upgrades.

9. Message, CCA-DS, 211645Z Oct 82, subject: Federal Telecommunicatioons System (FTS) Usage - DMATS St Louis and Ft Huachuca.

10. Center For Communications Management, Inc (CCMI) Interstate Services Rate Digest.

11. Control Data Management Institute, Control Data Corporation Telephone Systems: Selection, Operation and Management.

12. AT&T Telecommunications Glossary, 1983.

13. GSA letter, 21 Jun 84. No subject. Letter Projects FY 85 FTS Costs for the Army.

ANNEX D

ABBREVIATIONS

AMA	Automatic Message Accounting
AUTOVON	Automatic Voice Network
BOC	Bell Operating Company
CCS	Hundreds of Call Seconds
CONUS	Continental United States
DA	Department of the Army
DCO	Dial Central Office
D&D	Divestiture and Deregulation
DDD	Direct Distance Dialing
DMATS	Defense Metropolitan Area Telephone System
DOD	Department of Defense
FTS	Federal Telecommunications System
FX	Foreign Exchange
GOS	Grade of Service
GSA	General Services Administration
LCR	Least Cost Routing
HAC	House Appropriations Committee
LATA	Local Access Transport Area
TELPAK	Telecommunications Package
USACC	US Army Communications Command
USAF	US Air Force
USAISC	US Army Information Systems Command
USARCCO	US Army Commercial Communications Office
WATS	Wide Area Telephone Service

ANNEX E

LETTER TO 7TH SIGNAL COMMAND

DEPARTMENT OF THE ARMY
U.S. ARMY COMMUNICATIONS COMMAND
FORT HUACHUCA, ARIZONA 85613

JUN 22 1984

REPLY TO
ATTENTION OF

OPS

JECT: Procurement of Least Cost Routing (LCR) Devices through AR 5-4, Chapter 5, the Productivity Capital Investment Program (PCIP)

mander
Signal Command
N: ASN-OPS
t Ritchie, MD 21719

We are currently performing a program evaluation of CONUS telephone vices under the purview of this command. The purpose is two-fold. First, make a direct comparison of Federal Telephone Service (FTS) with other type ephone services, such as Wide Area Telephone Service (WATS), to determine t benefits to be derived from each service. Second, to develop an algorithm t will predict the optimum mix of telephone service at any given post, camp, station. Preliminary effort to date is limited to evaluating FTS vs WATS.

Ten different posts, camps, and stations have been selected for analysis ed on geographical location and mission to ensure a statistically correct ple is used. General Services Administration's (GSA) Automatic Message ounting (AMA) computer tapes were obtained for these sites. The tapes vide a 20 percent sample of all FTS calls made on a monthly basis. ormation includes telephone numbers of called party, length of call, time of , etc. Preliminary analysis of these tapes show that approximately -third of all FTS calls are made intrastate. GSA bills their customers roximately $.30 per minute per call regardless of whether the call is rastate or interstate. Current WATS rates for intrastate inter-LATA (Local ss and Transport Areas) vary by state, but are typically less than the FTS e. In some cases as much as two-thirds less.

It appears that if LCR devices were installed in the majority of posts, ps, and stations to block intrastate FTS calls and route them over other vices such as WATS, significant savings could be realized. The cost for an device ranges between $10K and $80K depending on features and capabilities. ds to procure these devices can be requested through AR 5-4, chapter 5, P, if the payback period is 4 years or less. Preliminary analysis shows s to be the case in almost every instance. There are additional benefits to derived from the LCR devices other than controlling intrastate FTS calls h as toll restricting. 7th Signal Command has evaluated these benefits ough earlier economic and other type analyses.

-OPS
JECT: Procurement of Least Cost Routing (LCR) Devices through AR 5-4, Chapter 5, the Productivity Capital Investment Program (PCIP)

7th Signal Command has recently submitted a request for several LCR devices rough PCIP. Though sufficient PCIP funds may not be available to purchase l the LCR's required, we encourage the efforts of your command to pursue the rchase of LCR's through PCIP.

Pending increased availability of LCR's acquired either through the CONUS dernization Program or PCIP, request you take necessary action to immediately duce intrastate FTS usage. Actions such as physically blocking subscriber cess to intrastate FTS service, and/or an aggressive subscriber information ogram should be considered as a minimum.

Information on this program evaluation will be provided upon request. ints of contact are Mr. Robert Priest and Mr. Joseph McCoy, AUTOVON 879-6811.

R THE COMMANDER:

EUGENE C. RENZI
Colonel, GS
DCSOPS

:
r, 7th Sig Comd (ASN-COMPT-MEA)
r, USARCCO
mptroller (AS-OC-SAS)

END

FILMED

11-85

DTIC